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EVALUATION OF THE OHIO WATER SUPPLY PROGRAM

Environmental Protection Agency
Chicago, Illinois

July 1972

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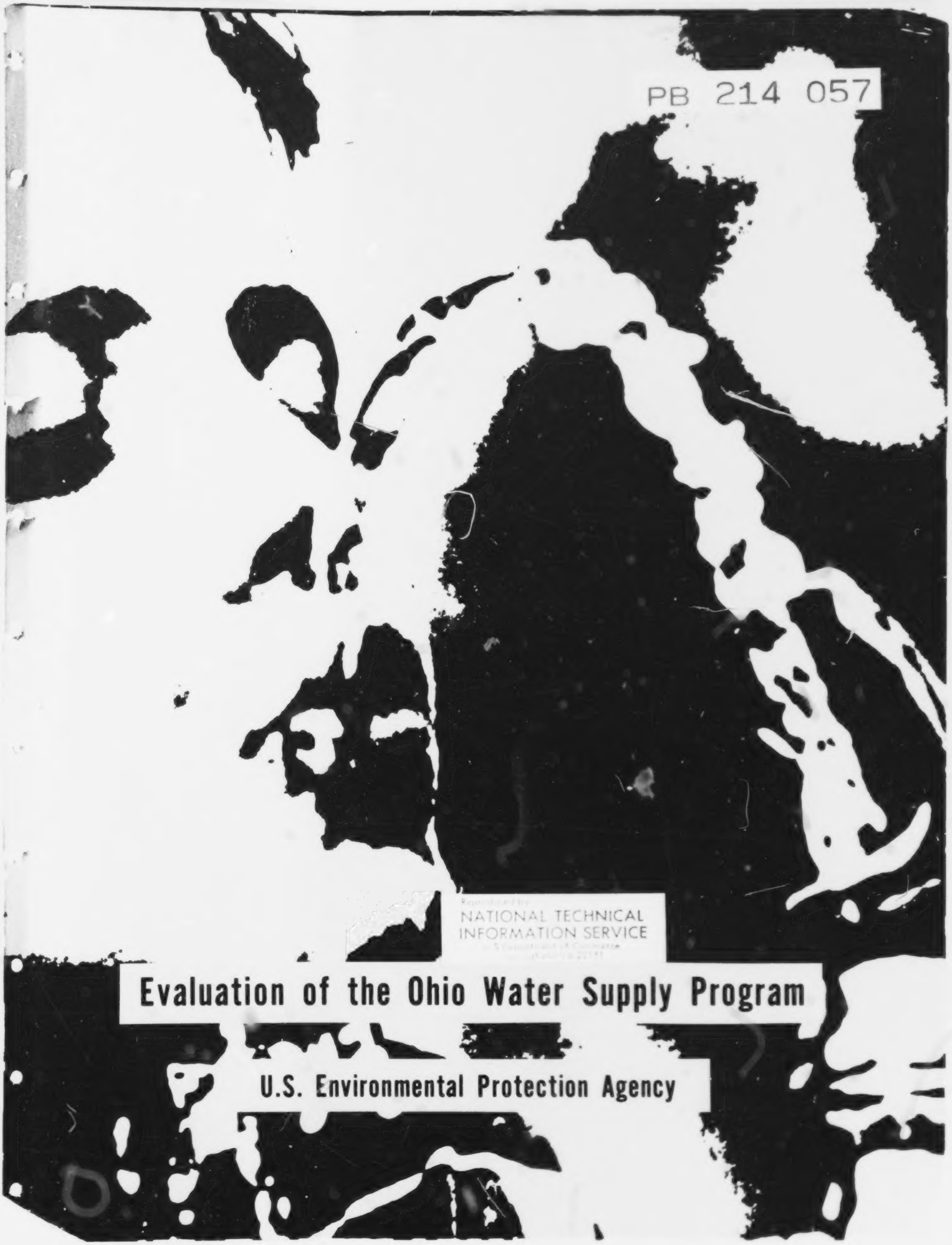

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Evaluation of the Ohio Water Supply Program

U.S. Environmental Protection Agency

Evaluation

# of the

Ohio Water Supply Program

U.S. Environmental Protection Agency
Region V
Division of Air and Water Programs
Program Support Branch
Water Supply Section

July 1972

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Preface

This report presents the Environmental Protection Agency's findings, conclusions, and recommendations, with supporting data and explanatory text of the study of the Ohio public drinking water supply program.

The information contained herein has been condensed and the significance of the findings is further discussed in a companion report, Evaluation of the Ohio Public Water Supply Program - Summary. The Summary highlights important results and areas of major need for those who have an interest in Ohio's drinking water but do not wish to study the detail of the complete report.

Table of Contents

Page Number

Preface i

Table of Contents ii

List of Tables iv

List of Figures v

Summary of Findings and Conclusions 1

- Community Water Supply Study of 1969 1
  - Community Water Supply Recommendations 4
- Community Water Supply Surveillance Effectiveness 5
- Community Water Supply Program 8
- Semi-Public Water Supply Program 10

Recommendations 11

Introduction 23

- Background 24
- Water Supply Definitions 26
- Purpose of Evaluation 27

Scope 29

Evaluation Criteria 35

Findings 37

- District Surveillance Data 37
  - Inspections 37
  - Chemical Analysis 51
  - PHS Standards Run 52
  - Monthly Reports 53
  - Bacterial Sampling 54
  - Bacterial Quality 54

- Special Fluoridation Studies 55
  - Field Study 55
  - Evaluation of Operator Training 61
  - Evaluation of Fluoridation Records 64

Discussion 65

Page Number

Public Water Supply Law, Regulations and Policy 65
Department of Health Public Water Supply Program Organization 70
  Community Water Supply Program 70
  Semi-Public Water Supply Program 73
Community Water Supply Activities 73
  Water Supply Unit Resources 73
  Water Supply Unit Activities 76
    Operations Section 77
      District Surveillance 77
      Records 77
      Fluoridation 78
      Cross Connection Control 81
      Wastewater Discharge Permits 81
      Special Studies and Activities 82
    Plans Review Section 83
    Water Quality Section 86
    Laboratory Support 88
      Sanitary Chemistry Laboratory 88
      Water Bacteriology Laboratory 90

District Operations ....

      Nortwest District - Bowling Green 94
      Southwest District- Dayton 97
      Northeast District- Cuyahoga Falls 97
      Southeast District- Nelsonville 99
      Procedures and Practices 99
        Inspections 99
        Inspection Training 101
        Water Supply Surveillance Records 101
        Master-Metered Water Supplies 104
        Plans Review 104
        Certification of Operators 104
        Cross Connection Control 105
        Chemical Results 105
        Water Supply Inventory 105
        Fluoridation 106

Division of Sanitation 107
Department of Natural Resources Water Supply Activities 114

Appendix A Operations Records 118
Appendix B Water Quality 139
Appendix C Manpower Needs for Community Water Supply Activities 179

List of Tables

Table #	Title	Page
1	Development of Municipal Water Supplies in Ohio	25
2	Sample Composition by Size	32
3	Sample Composition by Source	33
4	Operating Conditions at Selected Fluoridated Water Supply Systems in Ohio	59
5	Adequacy of Fluoridation at Selected Water Supply Systems in Ohio	60
6	Comparison of Operating Conditions at Fluoridation Installations in Ohio and Six Other States ..	62
7	Water Supply Unit Professional Staff Qualifications	75
8	Summary of Plan Approvals 1971	84
9	Number of Plans Approved 1961-1971	85
10	Northwest District Office- Percent of Time Spent on Water Supply	95

List of Figures

Figure Number	Title	Page
1	Distribution of Water Supplies Selected for Evaluation	31
2	Community Water Supply Surveillance in Ohio	38
3	Community Water Supply Surveillance in Ohio - Inspections	39
4	Community Water Supply Surveillance in Ohio - Chemical Analysis	40
5	Community Water Supply Surveillance in Ohio - PHS Standards Run	41
6	Community Water Supply Surveillance in Ohio - Monthly Reports	42
7	Community Water Supply Surveillance in Ohio - Bacterial Sampling	43
8	Community Water Supply Surveillance in Ohio - Bacterial Quality	44
9	Inspection Record, 1971 by District by Population Served	45
10	Chemical Analysis Record, 1971 by District by Population Served	46
11	PHS Standards Run, 1971 by District by Population Served	47
12	Monthly Reports, 1971 by District by Population Served	48
13	Bacterial Sampling Record, 1971 by District by Population Served	49
14	Bacterial Quality, 1971 by District by Population Served	50
15	Performance of Fluoridation at Selected Community Water Supplies	63
16	Ohio Department of Health, Division of Engineering Organization Chart	71

Preceding page blank

Figure Number	Title	Page
17	Water Supply Unit Organization	72
18	Department of Health Organization Chart	74
19	Northwest District Organization Chart	96
20	Southwest District Organization Chart	98
21	Ohio Department of Health- Division of Sanitation Organization Chart	108
22	Division of Sanitation Programs Delineation	109
23	Organization of the Ohio Department of Natural Resources	115

Summary of Findings and Conclusions

Recognizing that the health of over 10.6 million people in Ohio is directly dependent upon the condition of their drinking water, Dr. John Cashman, Director, Ohio Department of Health, requested that the Environmental Protection Agency (EPA) evaluate the Department's Water Supply Program. This report presents the EPA's findings, conclusions and recommendations, with supporting data and explanatory text of that evaluation.

Approximately 8.7 million people in Ohio are served by 812 "community" water supplies. Another 2,000,000 rural residents obtain their drinking water from individual water systems. In addition, there are an unknown number of semi-public water supplies at restaurants, service stations, recreational facilities, amusement parks, etc.

The effectiveness of the Ohio Water Supply Program was judged primarily on the bases of Health Department District Office surveillance records and past studies of water supplies in Ohio. Records of 20 percent of the community water supplies under District Office surveillance were examined for inspections, chemical analyses, bacterial sampling, bacterial quality, and monthly operating reports. The study of water supplies in Ohio from which data is drawn to indicate the condition of community water supply facilities is the "Community Water Supply Study, Cincinnati, Ohio, Standard Metropolitan Statistical Area, 1969."

Community Water Supply Study of 1969

The Community Water Supply Study of 1969 (CWSS) included detailed analysis and study of 33 community water supplies in the Ohio portion of the Cincinnati metropolitan area. These water supplies were considered to represent conditions similar to those occurring in many water supplies in Ohio. The principal findings of the CWSS were:

Water Quality - Bacteriological

Twenty-four percent of the community water supplies examined did not meet the bacteriological quality standards one or more of the 12 months preceding the study. These supplies served about 27,600 people (about three percent of the total population served).

Fifty-eight percent of the community water supplies examined did not meet the bacteriological sampling standards for the 12 month period preceding the study. These supplies served about 111,000 people (about 11 percent of the total population served).

Water Quality - Chemical

All of the community water supplies examined met the mandatory chemical drinking water standards.

Twelve percent of the community water supplies examined did not meet one or more of the recommended drinking water standards. These supplies serve about 21,500 people (about two percent of the total population served) with aesthetically inferior water.

No water supply had chemical data taken on an annual basis for more than ten of the 26 parameters listed in the 1962 Public Health Service Drinking Water Standards (DWS).

Only nine percent of the water supplies examined provided fluoridated water. These supplies served 28,000 people (less than three percent of the total population served).

Facilities

Major facility deficiencies found were: inadequate source protection - 52 percent of the water supplies examined, serving 84,000 people (eight percent of the total population served); inadequate treatment capability - 21 percent, serving 29,000 people (three percent of the total population served); low pressure areas - 12 percent, serving 4,400 people (less than one percent of the total population served); inadequate maintenance - 21 percent, serving 30,000 people (three percent of the total population served).

Operation

None of the 33 water supplies examined conducted an effective cross connection control program.

Thirty-three percent of the water supplies examined did not have certified operators.

Twenty-four percent of the water supplies examined did not have full time operators.

Chlorine residuals taken on 26 of the supplies examined showed 73 percent were not maintaining residuals of 0.2 ppm or greater throughout their distribution systems despite State Department of Health policy recommending 0.2 to 0.4 ppm throughout the distribution system. Daily check samples of chlorine residuals at the treatment plants were not taken by 37 percent of the water supplies examined.

Community Water Supply Study Recommendations

From the above findings the following recommendations were made:

I. More emphasis should be placed upon the public health surveillance of public water supply systems. This should be accomplished by increasing Water Supply Program staffs of State and local health departments. Increased State surveillance should be directed to:

a. Adequate quality surveillance in accordance with State and local policies.

b. Annual visitation and sanitary survey of public water supply systems by the appropriate regulatory agency. Present visits often do not include a complete sanitary survey of the systems visited.

c. Planning for future development.

II. Operator training should be expanded and water works operators should be made aware of the importance of participating in available training couses.

III. Effective cross connection control programs should be developed for the elimination of sanitary defects in community water supply systems.

IV. Laboratory capabilities should be increased for both State and local facilities.

V. Major shortcomings in water supply operating practices should be corrected.

VI. More adequate funding for management, operation, and improvement of water supply facilities should be provided.

VII. Where practical, all community water supply systems should provide fluoridation.

VIII. The proliferation of small systems should be discouraged. Where possible, existing small systems should be merged with large systems and new service areas should be served by the larger systems.

Since the completion of the CWSS several steps have been taken within the Department of Health in response to these recommendations. Laboratory support has been considerably increased with a definite, scheduled chemical sampling program established and routine analysis expanded from nine DWS parameters to 16 parameters with 13 additional parameters routinely determined. Plans have been made to perform all DWS parameters routinely. Another major step taken was the preparation and adoption of a modern State cross connection control regulation. Inspection frequency was also increased.

Community Water Supply Surveillance Effectiveness

Examination of District Office records of 20 percent of the water supplies listed in the "1968 Municipal Water Supply Inventory" (every fifth water supply was selected) revealed the following status:

Inspections

Thirty-two percent of the community water supplies were not inspected in 1971. Data was unavailable on seven percent of the water supplies due to misplaced records. Seventy-three percent of the master-metered supplies were not inspected in 1971. The inspection program was concentrated on water supplies serving more than 5,000 people (79 percent done in 1971).

Bacterial Water Quality

More community water supplies failed the PHS Drinking Water Standards one or more months in 1971 (24 percent) than met the standards for the 12 months of 1971 (23 percent). Bacterial quality could not be judged for 53 percent of the water supplies examined due to less than six months of adequate sampling or inadequate record keeping. Sixty-five percent of the supplies serving more than 5,000 people have unknown (in the District Office) bacterial quality due primarily to the practice of not recording such information in two Districts. About 50 percent of the supplies serving fewer than 5,000 people and 94 percent of the master-metered supplies have unknown bacterial quality due primarily to inadequate sampling.

Bacterial Sampling

Sixty-seven percent of the community water supplies examined failed to meet the bacterial sampling standards two or more months in 1971. Complete records could not be found on 19 percent of the water supplies examined. Seventy-four percent of the supplies serving fewer than 5,000 people and all of the master-metered community water supplies failed to meet the bacterial sampling standards two or more months in 1971. Data was unavailable for 38 percent of the supplies serving more than 5,000 people due to record keeping procedures.

Chemical Analysis

Seventy-three percent of the community water supplies examined were provided with chemical analysis in 1971. All of the surface supplies and 95 percent of the supplies serving more than 5,000 people were provided with analysis. Analysis was not provided for 73 percent of the master-metered supplies. Data was not available on five percent of the supplies examined.

PHS Standards Run

Sixty-four percent of the community water supplies examined were provided in 1971 with analyses of 15 or more of the 26 parameters listed in the 1962 Public Health Service Drinking Water Standards. Eighty-four percent of the supplies using surface water received these analyses. Seventy-nine percent of the master-metered supplies did not receive these analyses. Six percent of the supplies examined did not have data available on the parameters analysed.

Monthly Reports

Fifty-five percent of the community water supplies examined provided monthly reports for 11 or 12 months of 1971. Seventy-nine percent of the supplies serving more than 5,000 people and 88 percent of the supplies using surface water provided monthly reports for 11 or 12 months of 1971. Sixty-seven percent of the supplies serving fewer than 1,000 people and 79 percent of the master-metered supplies provided monthly reports for less than 11 months of 1971.

Community Water Supply Program

The funds expended for community water supply protection in Ohio are inadequate to accomplish effective surveillance. The Division of Engineering administers the program with funds estimated at $126,000 (FY 1971 including District Office staffing and travel). Laboratory support, administered by the Division of Laboratories, is good, with funds estimated at $84,000 (FY 1971). Including laboratory support, about 2.5 cents per capita served per year is spent on protection of community water supply. A study of the 1970 budgets for State and territorial water supply programs showed that Ohio ranked 53rd out of 56 programs based on per capita expenditure.

Staff limitations, particularly in the District Offices, have prevented the Water Supply Unit from fulfilling its responsibilities. The Community Water Supply Study of 1969 found many deficiencies in supplies and their operation. Due to the fact that only 2.9 man years of professional staff were available in 1970 for surveillance work, surveillance was often performed in a cursory manner, seriously reducing the effectiveness of the program. The evaluation of surveillance performance parameters reveals gross inadequacies in bacterial quality surveillance and monthly operational reporting.

The Department of Health has been reluctant to issue orders for correction of water supply deficiencies. Primary reasons for this appear to be lack of specific regulations on design and water quality required, lack of expeditious administrative and judicial process, and lack of well oriented legal aid and assistance in preparing cases for action.

Current community water supply regulations deal with the processes for plans review, operator certification, and cross connection control. Standards for bacterial, chemical, radiochemical and physical drinking water quality are not specified in the regulations. Design standards for plans are not specified in the regulations. State law apparently does not authorize the Department of Health to establish drinking water quality standards. No provision is made for the orderly development of new community water supplies. Considering the definitions of public water supply and community water supply (see pages 26 and 27), it is apparent that the present water supply inventories do not include many of the smaller water supplies.

The Division of Engineering's community water supply policy is contained in a number of documents and memoranda issued over several years. The lack of a single complete policy document makes agency-wide knowledge of the policies and uniform application difficult.

There are 241 community water supplies that are required by Division of Engineering policy to obtain bacterial analyses from non-State laboratories. There are 165 supplies that presently use 153 laboratories which are certified every three years by the Division of Laboratories. The State provides excellent bacterial and chemical analysis service. The chemical analysis service has improved markedly in the past two years. Certification of non-State laboratories providing surveillance analyses (the required annual or quarterly chemical samples as distinguished from the daily or weekly chemical samples [operational analyses]) is not provided.

Effective utilization of computer services has not been obtained. The large amounts of data which are collected must be processed and analysed by "hand." Consequently, the data are seldom given proper attention and are not effectively assimilated to direct program activities since the process is too time consuming.

Semi-Public Water Supply Program

There are dual responsibilities for semi-public water supply activities shared by the Division of Sanitation and the Division of Engineering. Inspection of semi-public water supplies is largely delegated to County Boards of Health. Water quality analysis requirements are far less definitive than those for community water supplies. Several types of semi-public water supplies receive little or no surveillance. Although there is no inventory of semi-public water supplies, available records indicate that between 2,500 and 3,000 semi-public water supplies are presently under surveillance. Adequate surveillance over these supplies would require program funds of over $500,000 in inspection services and laboratory support.

In summary, the Ohio public water supply program is not providing adequate health evaluation and engineering services necessary to fulfill its responsibilities to protect the health of the citizens of Ohio. Community water supply operators are not cooperating with the State in attaining adequate health surveillance. To properly provide such services and obtain adequate health evaluation, the following recommendations are made.

Recommendations

It is recommended that:

1. The community water supply program be identified in budget planning, appropriations, and accounting as a line item. A minimum annual budget of $600,000 should be provided. The funds should be used for:

Community Water Supply Activities (Water Supply Unit and District Offices)	$400,000
Laboratory Support	200,000
	$600,000

2. The public water supply program (headquarters and District Offices) be staffed with a minimum of 20 professional staff on community water supply activities. This estimate does not include personnel for the surveillance of water supply waste discharge facilities. (Appendix C.)

3. The District Offices be made responsible to the headquarters water supply program to achieve adequate surveillance, with at least three professional personnel assigned full time per District to community water supply activities.

4. The Division of Engineering increase and improve surveillance of public water supplies to the levels s[illegible]ineering policy. These levels include:

a. Annual sanitary surveys of each community water supply. Priorities and time schedules should be established for eliminating deficiencies.

b. Detailed sanitary surveys every three years for each community water supply.

c. Bacterial surveillance and monthly reporting meeting State established requirements. This requires co-operation of water supply operators (see recommendation 6.c.).

d. Complete routine chemical analysis of all community water supplies.

5. Semi-public water supplies be inventoried. An evaluation of the semi-public water supply surveillance provided by local Boards of Health be conducted.

6. Automatic data processing techniques be used for storage, analysis, and retrieval of water supply data.

7. The water supply functions of data development on raw water sources and water supply planning within the Department of Natural Resources and of community water supply activities within the Department of Health be closely coordinated and utilize the same data storage and retrieval system.

8. The water supply regulations be revised and expanded to more comprehensively reflect current recommended water supply practice. The following specific features should be included:

a. Quality standards for finished drinking water.

b. Mandatory disinfection of all community water supplies.

c. Continuation of certification dependent upon operator compliance with State requirements for the operation of a water supply.

d. Definition of community water supply and semi-public water supply.

e. Design standards for water supply development.

f. Application of quality and design standards to semi-public water supplies.

9. A uniform State-wide regulation controlling drilling practice be established with enforcement through licensing and periodic State evaluation of performance.

10. Policies and regulations be established to provide for and control the orderly development of new community water supplies. These policies and regulations should discourage the proliferation of small independent supplies and should encourage the consolidation of supplies.

11. A single document be prepared and distributed to all District Offices and community water supplies which presents all current Ohio public water supply program policy. Provision should be made for updating this document as policy revisions occur.

12. Legal support sufficient to provide legal consultation and to take timely action against violations of State water supply laws and regulations be provided to the Water Supply Unit.

More specific recommendations for implementing various program activities are:

1. Inspections

a. A tie should be established between the Plan Review Section and the District Offices whereby District Office inspections are utilized to determine the degree of implementation of approved plans for water supply construction and development. Where approved plans are not followed or are not obtained for such construction, action should be taken to obtain correction of the violation.

b. Each water supply inspector should receive training by the central office in the conduct of inspections. This training should be developed by the central office and the District Offices working in concert. Each inspector should utilize an inspection form developed and provided by the central office to assure complete inspection. This should be used regardless of the age or experience of the inspector.

c. Ratings used on inspection sheets should be clearly defined. The training referred to in 1.b. should emphasize interpretation and application of the ratings. The ratings should be brought to the attention of the operators and should be emphasized in official communications to those responsible for the water utility.

d. Master-metered supplies should be inspected annually. District Offices should emphasize that master-metered supplies are required to conduct bacterial sampling programs and must submit monthly operating reports.

2. District Operations (other than inspections)

a. Standard procedures for effective record keeping should be developed by the Water Supply Unit and provided to the District Offices. Water Supply Unit personnel should assist in implementing these procedures during visits to the District Offices which should include review of District records. District records should provide complete surveillance data at least in the form of monthly summaries for each water supply (including sample results from non-State laboratories). At any time the preceding year's record should always be available in the District records for each water supply. "Key" records based upon at least one year's past monthly operational, chemical use, and bacteriological reports should be developed for each water supply. The "key" records should be used to check for variations in the monthly reports received.

b. District Office personnel should establish close liaison with local comprehensive health planning "B" agency environmentalists and obtain "B" agency support for water supply improvement.

c. Inspectors should be trained and provided with basic testing equipment (such as ammonia for chlorine leak detection) for dealing with emergencies. All inspectors should be provided with and trained to use routine test equipment such as chlorine and pH kits.

d. Inspectors should be familiar with certification requirements and opportunities, and should be familiar with and involved in training being conducted within the District. Inspectors should be prepared to provide pertinent timely information on training and certification on every inspection. In addition, inspectors should follow up on training received by specific operators to ascertain the effectiveness of the training and enhance the effectiveness of the training.

3. Laboratory Support (Chemical)

a. Quality control should be established on a routine basis. The Chief Chemist should be oriented through a short course in Analytical Quality Control. As part of the quality control program Analytical Reference Service samples should be analysed and certification by the Analytical Reference Service should be obtained.

b. To assure consistent and dependable analyses by non-State laboratories, a chemical laboratory certification program should be established. This certification program should include inspection of laboratory facilities, review of techniques and practices, and the provision of reference samples. In addition,

(1) The chemical laboratory certification program conducted by the Division of Laboratories should not include direct certification of water supply laboratories conducting only routine operational control analyses done by the operator.

(2) District Office personnel responsible for conducting inspections of the water supplies should be trained in inspecting elementary laboratories, and reviewing analytical techniques and procedures used for the routine operational control analyses. One of the duties of the District Office personnel should be assuring that routine operational analyses are properly conducted and are effectively interpreted and used by the operator.

(3) Part of the operator's certification requirements should be the passing of a test designed to ascertain the operator's capability to conduct routine operational control analyses and interpret the analyses' results.

(4) At least one qualified individual should be assigned full time to develop and initiate the chemical laboratory certification program and water supply surveillance training program in routine operational control analysis evaluation.

c. Metal samples and samples for nitrate and surfactant analysis should be properly preserved by the use of nitric acid and mercuric chloride respectively.

4. Laboratory Support (Bacterial)

a. Bacterial surveillance policy should be revised as follows:

(1) Master-metered water supplies serving more than 10,000 people should be required to contract for or provide for distribution system bacterial sample analyses.

(2) All water supplies providing chlorination should be required to maintain daily chlorine residual records for water leaving the treatment plant. For surface water supplies serving fewer than 1,000 people, weekly bacterial samples should be required of the source and treatment plant effluent where the chlorine residual records are satisfactory.

(3) With the adoption of recommendation 4.a.(2), the requirement that all surface water supplies provide for bacterial analysis by non-State laboratories should be revised to

permit the provision of State laboratory service to the 28 surface water supplies serving fewer than 1,000 people.

5. Fluoridation

a. Where violation of the mandatory fluoridation law is occurring, action should be taken by District personnel to determine the reasons why fluoridation has not been initiated and how the Water Supply Unit can assist in obtaining fluoridation.

b. Where compliance with the law does not appear to be forthcoming, legal action through the Attorney General's office to obtain compliance should be initiated.

c. The Water Supply Unit should consult with the Department of Health, Division of Dental Health and develop a brochure of pamphlets providing information on the benefits of fluoridation for distribution to concerned operators.

d. A computer program should be developed to calculate daily fluoride concentrations from fluoride use and water production data provided by the operators' monthly reports. These calculated values should be compared by computer to State standards and operator analysis. Variation of calculated values from the State standards and from operator analysis should be reported by the computer, and this information should be transmitted to District personnel for action.

e. Results of monthly duplicate fluoride analysis samples (maintained by the Sanitation Chemistry Laboratory) should be provided on a timely basis to appropriate Water Supply Unit and District personnel.

f. The operators at all fluoridation installations should be required to conduct fluoride ion analysis according to Standard Methods to within ± 0.1 mg/l of the value reported on the State check sample. Daily finished water fluoride ion analysis, regular raw water fluoride ion analysis, adequate laboratory equipment and care of equipment, and complete records on the fluoridation operation should be enforced at all fluoridation installations.

g. Water Supply Unit personnel should be trained to assist and should assist operators as needed during "start-up" periods of new fluoridation installations. District Office inspectors should be trained to recognize deficiencies in fluoridation equipment and should be familiar with steps necessary to correct such deficiencies.

h. All water plant operators feeding fluorides should be instructed on safe handling and storage practices for fluoride chemical compounds. District Office inspectors should assure that the precautionary requirements for handling and storing fluoride chemical compounds developed by the State Division of Occupational Health are followed by the operator.

i. Training of operators should be improved with emphasis on accuracy in fluoride ion analysis, the benefits of continuous fluoridation, and proper operation of feed equipment. Satisfactory completion of training should be a mandatory requirement of the plant operator for approval of his installation to feed fluorides. District Office inspectors should receive the same training and should assure during inspections that training has been effective and is being implemented.

j. The Water Supply Unit should enforce the "Recommended Procedure for Control of the Fluoridation Process" requiring monthly check samples to be collected from the distribution systems of fluoridated water supplies and sent to the laboratories of the Department of Health for fluoride ion analysis. Significant interruptions in the fluoridation operations should be investigated by the District Office inspectors and all plants employing new operating personnel placed in charge of the fluoridation operation should be visited immediately to assure the new operator has been adequately trained.

6. Water Supply Unit, Operations Section

a. An implementation plan for utilization of the April 1972 cross connection control regulation should be developed. This plan should outline actions necessary to make the regulation effective, define the manpower necessary to take these actions, define the relationships necessary with other State and local agencies and establish the training necessary for implementation by the Water and Wastewater Operators Committee of Ohio.

b. One individual should be assigned full time to work on water supply operator certification and to assist the Operator Training Committee in the development and conduct of water supply operator training.

c. The definition of areas of the State presently provided with water supply distribution mains should be completed and kept up-to-date through co-ordination with the Plans Review Section and the District Offices.

d. Data handling, analysis and use should be improved by:

(1) The development of computer programs for the storage, selective retrieval, and manipulation of monthly reported and inventory data.

(2) The provision of summaries of monthly reported data on each supply periodically to the District Offices.

(3) The provision of summaries of violations of State policies and standards on a monthly basis to the District Offices.

(4) The provision of community water supply inventories, by District, to the District Offices with annual update provided.

(5) Inventory check by District Offices during inspections to assure accuracy with corrections reported to the Water Supply Unit.

(6) The provision of annual summaries of monthly reported data to reporting operators.

e. Operator training needs should be evaluated and defined. Past training provided should be reviewed and evaluated for effectiveness in reaching the operators needing training and for effectiveness in providing the training needed. Such evaluations should be conducted in close co-operation with the Operator Training Committee of Ohio.

Introduction

In 1969 the Bureau of Water Hygiene, Environmental Health Service (now the Division of Water Supply Programs, Environmental Protection Agency) conducted an extensive study of public water supplies. Every public water supply system in each of nine designated areas, including the Cincinnati, Ohio standard metropolitan statistical area, was subjected to a field inspection and evaluation. On an overall basis, this study showed that inadequate operating procedures, physical facilities and surveillance activities are common in both large cities and small towns, irrespective of geographical location.

In reaction to this study and their own concern, several State health officers requested that the Regional Offices of the Environmental Protection Agency (EPA) evaluate their State water supply surveillance programs. In addition, the Conference of State Sanitary Engineers has urged the development of a co-operative program for evaluation of State water supply surveillance activities. In response to this need, the Division of Water Supply Programs of EPA planned to provide the manpower and technical assistance necessary to complete ten such evaluations nationwide in fiscal year 1972. These evaluations were to be made upon State request under the provision of the Public Health Service Act which authorizes the Surgeon General to assist State public health agencies.

In September, 1971, the availability of this evaluation service was made known to Dr. John Cashman, who became Director of the Ohio Department of Health in April, 1972. Reflecting his interest and concern for the importance of water supplies to public health, Dr. Cashman indicated

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that such an evaluation of the State public water supply program would be timely and requested a project proposal. The project proposal was prepared and reviewed with Dr. Cashman's staff in December, 1971. The project proposal did not call for complete public water supply surveys due to the data available from the Community Water Supply Study of 1969. The project was initiated in early January, 1972.

Background

Ohio was admitted to the Union as the seventeenth State in February, 1803. Its population was small, as shown by the census of 1800, with only 45,365 people registered. Growth was rapid, however, and by 1810 the population had reached 230,760.

The rapidly growing population created a need for community water supplies in population centers. Cincinnati was the first municipality in Ohio to install a community water supply (1821). Table 1 shows the growth in the number of incorporated municipal water supplies since 1820. The number of community water supplies, including those serving unincorporated areas, has grown to 812 (January, 1972). Enumeration of community water supplies is found in the Water Supply Unit's "1968-69 Water Plan Inventory of Public Water Systems" and the "Ohio Water Quality Surveillance of Community Water Supply Systems 1972."

The 1970 census determined that 10,652,000 people reside in Ohio. Over 8,720,000 of these people are served by the 812 community water supplies (1972 listing). This number does not include 65 community water supplies which were proposed or under construction in January of 1972. In addition to the community water supplies, there are an unknown

Table 1

Development of Municipal Water Supplies in Ohio

Date	Incorporated Municipalities Having Separate Supply Works	Population Served	Percent of Entire State Population
1820	0	0	0
1830	1	24,800	2.6
1840	3	52,900	3.5
1850	4	130,700	6.6
1860	6	221,600	9.5
1870	11	379,700	14.3
1880	30	740,600	23.2
1890	78	1,399,900	38.3
1900	172	2,057,000	49.6
1910	237	2,804,300	58.9
1920	277	3,867,000	67.1
1930	319	4,782,800	72.0
1940	414	4,961,500	71.9
1950	467	5,676,300	71.5
1960	521	6,830,800	70.4
1970	571	8,500,000	79.8

number of semi-public water supplies which serve millions of people at restaurants, service stations, recreational facilities, trailer parks, and similar establishments.

The early experiences of municipalities with epidemics of typhoid fever and other water borne diseases demonstrated to the people of Ohio that a distinct health problem presented itself in the use of unsafe public water supplies. Responsibility for controlling public water supply development was vested in the Department of Health in 1893. At this time the legislature required municipalities and private corporations to obtain approval of public water supply plans from the Department of Health before the supply could be constructed (Section 3701.18 Revised Code). The law further stated (Section 3701.22), "The department of health may maintain a chemical and bacteriological laboratory for the examination of public water supplies.... The department shall examine and report each year the condition of all public water supplies." This latter statement authorizes the general supervision of the operation of water supply systems. Later changes and additions in the Ohio Revised Code elaborated upon these responsibilities.

Water Supply Definitions

The following definitions of water supply apply in the State of Ohio and are used in this report.

Public water supply - any water supply intended for human consumption at a place or building, except for any water supply which serves only a private dwelling.

Community water supply - any public water supply providing water to any building housing more than three families or to more than one separately owned property.

Semi-public water supply - any public water supply providing water to an establishment to which non-residents have ready access on a regular or intermittent basis.

Private water supply - any water supply serving a building housing fewer than four families or serving a privately owned property not readily accessible to the public.

Ground water supply - any water supply obtaining water from the ground through wells or other like facilities.

Surface water supply - any water supply obtaining water from surface water sources such as streams, lakes, or springs.

Master-metered water supply - any community water supply which obtains water from a ground water supply, surface water supply, or master-metered water supply.

Purpose of Evaluation

Specifically this evaluation endeavored to:

1. Ascertain the status of community water supply surveillance through review of pertinent data recorded by District Offices of the Ohio Department of Health.

2. Determine the adequacy of legal statutes, budget, manpower resources, regulations and policies, and laboratory support.

3. Make recommendations as to what additions and revisions should be made in the public water supply program to assure adequate health protection for the citizens of Ohio.

Surveillance Effectiveness

As previously noted (page 1), there were 812 community water supplies serving 8,720,000 people as of January, 1972, in Ohio. Enumeration of these supplies alphabetically for the State is found in the "Ohio Water Quality Surveillance of Community Water Supply Systems - 1972." This listing was not available at the time the Evaluation was initiated. Consequently, the "1968-69 Water Plan Inventory of Public Water Systems" which lists community water supplies alphabetically by county was used to evaluate surveillance effectiveness.

The "1968-69 Inventory" lists 750 community water supplies. It was determined by the EPA Regional Office that a 20 percent sample of these supplies would be sufficient to judge the effectiveness of the Ohio Community Water Supply Program. Since direct surveillance is provided by the four District Offices, evaluation of the surveillance provided by the Ohio Water Supply Program was made dependent on data available from the District Offices.

The sample for evaluation was selected by arranging the county listings from the "1968-69 Inventory" alphabetically by county for each District and then selecting every fifth supply (154 supplies were thus selected). This method of selection was considered to provide a random sample. The size of the sample assured adequate representation of community water supplies by size and type of source. The method of sample selection assured that supplies from every geographical area of the State were included. The locations of the supplies selected for

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study are shown by Figure 1.

The 154 community water supplies selected were examined for degree of representation by size (population served) and source. Tables 2 and 3 show the analysis of the sample. This analysis shows the sample provided data sufficient to judge:

1. Surveillance effectiveness with regard to size and type of source on a State-wide basis.
2. Surveillance effectiveness with regard to size and type of source on a District basis (with the exception of surface water sources in the Southeast District).
3. Comparison of surveillance effectiveness by size and type of source on a State-wide basis.
4. Comparison of surveillance effectiveness by size and type of source on a District basis (with the exception of surface water sources in the Southeast District).
5. Comparison of surveillance effectiveness by District (such comparison should be tempered by the notation of the differences in representation of size and type of source classes).
6. Comparison of surveillance effectiveness by District for ground water sources.
7. Comparison of surveillance effectiveness by District for each size class.

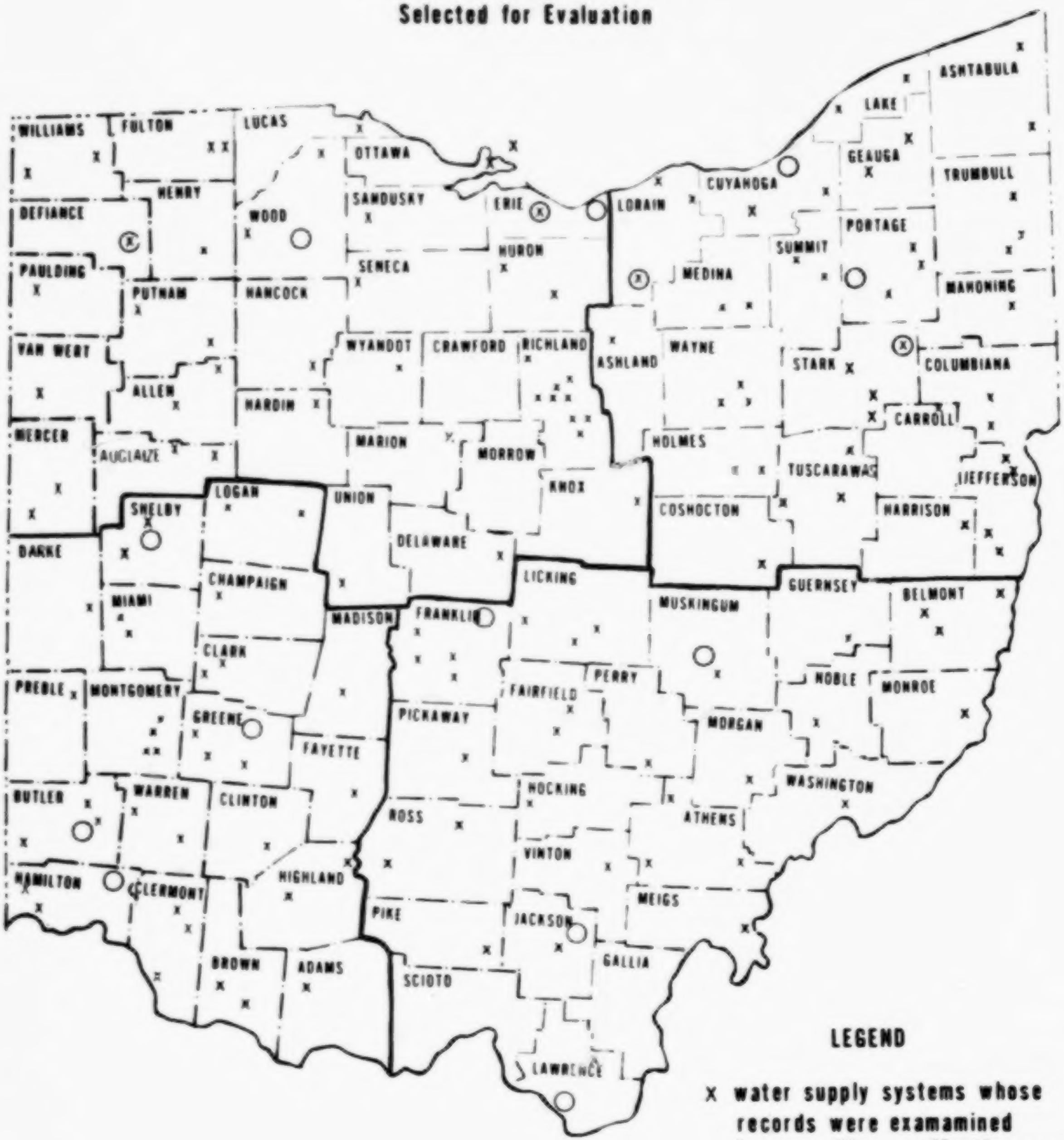
Program Evaluation

The basic water supply authorizations in the State Revised Code (law), regulations and program policies were reviewed. The Water Supply

Figure 1

Evaluation of Community Water Supplies in Ohio

Distribution of Water Supplies Selected for Evaluation


WILLIAMS
FULTON
LUCAS
OTTAWA
HENRY
WOOD
SANDUSKY
ERIE
LORAIN
CUYAHOGA
LAKE
GEAUGA
ASHTABULA
TRUMBULL
DEFIANCE
PAULDING
PUTNAM
HANCOCK
SENECA
HURON
MEDINA
SUMMIT
PORTAGE
MAHONING
VAN WERT
ALLEN
WYANDOT
CRAWFORD
RICHLAND
ASHLAND
WAYNE
STARK
COLUMBIANA
MERCER
AUGLAIZE
HARDIN
MARION
MORROW
HOLMES
CARROLL
TUSCARAWAS
JEFFERSON
SHELBY
LOGAN
UNION
KNOX
COSHOCTON
HARRISON
DARKE
DELAWARE
LICKING
MUSKINGUM
GUERNSEY
BELMONT
MIAMI
CHAMPAIGN
MADISON
FRANKLIN
CLARK
PERRY
NOBLE
MONROE
PREBLE
MONTGOMERY
GREENE
FAIRFIELD
PICKAWAY
MORGAN
FAYETTE
WASHINGTON
BUTLER
WARREN
CLINTON
HOCKING
ROSS
ATHENS
VINTON
HAMILTON
CLERMONT
HIGHLAND
MEIGS
PIKE
JACKSON
GALLIA
BROWN
ADAMS
SCIOTO
LAWRENCE

LEGEND

x water supply systems whose records were examamined for surveillance effectiveness

○ fluoridated water supply systems selected for special study

Table 2

Sample Composition by Size

District	Population Served										
	< 1000			1000 - 5000			> 5000			Total	
	Total Supplies	Sample Supplies	Percent Sampled	Total Supplies	Sample Supplies	Percent Sampled	Total Supplies	Sample Supplies	Percent Sampled	Total Supplies	Percent Sampled
SE	69	13	19	54	10	19	32	8	25	155	20
SW	57	9	16	70	15	21	49	13	27	176	21
NE	72	16	22	75	19	25	67	10	15	214	21
NW	83	20	24	83	15	18	39	6	15	205	20
Total	281	58	21	282	59	21	187	37	20	750	21

Table 3

Sample Composition by Source

District	Source								
	Surface Water			Ground Water			Master-Metered Water		
	Total Supplies	Sample Supplies	Percent Sampled	Total Supplies	Sample Supplies	Percent Sampled	Total Supplies	Sample Supplies	Percent Sampled
SE	26	1	4	111	24	22	18	6	33
SW	25	5	20	141	30	21	10	2	20
NE	48	7	15	141	33	23	25	5	20
NW	52	12	23	143	27	19	10	2	20
Total	151	25	17	536	114	21	63	15	23

Program's activities and staffing were also examined in both the Water Supply Unit and District Offices.

The Department's Division of Laboratories, Sanitation Chemistry Laboratory was evaluated and the community water supply chemical surveillance program was studied.

A special study of the fluoridation program was made. This study included inspection of 16 representative fluoridating supplies for evaluation of fluoridation practice. In addition, the records for all water supplies fluoridating or naturally fluoridated were reviewed and evaluated.

Evaluation Criteria

The effectiveness of the Ohio Water Supply Program was determined by review of District Office records on 154 community water supplies. These records included folders on each supply, bacteriological sample summaries, inspection logs and operator report logs. The records were examined in mid-January 1972. Parameters used for the evaluation of surveillance were either primarily dependent on the Water Supply Program's activity or on the operator's response to State requirements for surveillance. The date of last inspection, date of the last sample collected for chemical analysis and number of analyses for parameters listed by the PHS Drinking Water Standards of 1962 are dependent on Water Supply Program activity. Monthly operating reports, bacteriological sampling, and bacteriological quality records are dependent on operator activity. These parameters were evaluated on the basis of Ohio Water Supply Program policies.

Inspections

The Ohio Department of Health has a policy of conducting at least annual inspections of community water supplies. This policy also calls for comprehensive detailed surveys of each community water supply every five years. Comprehensive detailed surveys, however, are not being done. Inspection records were judged satisfactory if a recorded inspection was conducted in 1971.

Chemical Analysis

In October 1970, the Ohio Water Supply Program initiated a program of at least annual chemical sampling of community water supplies and quarterly sampling of surface community water supplies. Sampling was judged to be adequate if a sample was analysed in 1971.

PHS Standards Run

The policy of routine analysis for 15 of the parameters of the Drinking Water Standards was established by the Ohio Water Supply Program in early 1971. Analysis was considered adequate if 15 or more of the DWS parameters were determined for the last analysis of record.

Monthly Reports

All community water supplies are required to submit monthly operating reports prior to the fifteenth of the following month. Performance in this regard was considered satisfactory if 11 or 12 monthly reports had been received in 1971.

Bacterial Sampling

Bacterial sampling policy was established by the Ohio Water Supply Program in May 1967. Bacterial sampling was judged inadequate if the Ohio Water Supply Program policy was not met for two or more months in 1971.

Bacterial Quality

Bacterial quality data available in the District Offices was examined for comparison to the 1962 Public Health Service Drinking Water Standards. If bacterial quality failed to meet the DWS one or more months in 1971, bacterial quality was judged unsatisfactory. If bacterial sampling did not meet Ohio Water Supply Program policy for seven or more months of 1971, or if the bacterial quality records did not provide sufficient data to judge bacterial quality by the DWS, the quality was considered unknown.

Findings

District Surveillance Data

The findings of the evaluation of surveillance data are illustrated by Figure 2, showing State-wide data for the six parameters examined, Figures 3-8, showing State-wide data for the six parameters by population served and water source, and Figures 9-14, showing data for the six parameters by population served by District. With few exceptions the Figures show serious deficiencies in community water supply surveillance.

Inspections

Failure to conduct critical, timely inspections results in perpetuation of poor operating practices which expose the people served to potential health hazards.

Figure 2 shows that 61 percent of the community water supplies were inspected in 1971. No records of inspections could be found on seven percent of the community water supplies.

Inspection performance is shown by Figure 3 to be poorest for the smaller water supplies (those serving fewer than 5,000 people) with 52 percent inspected. Seventy-nine percent of the larger supplies (those serving more than 5,000 people) were inspected. With regard to source, only 27 percent of the master-metered water supplies were inspected in 1971. Ground and surface water supplies have better records with 63 and 72 percent, respectively, inspected.

Figure 9 shows inspection performance on a District by District basis for the sample and by population served. These data, in addition

Figure 2

Community Water Supply Surveillance in Ohio

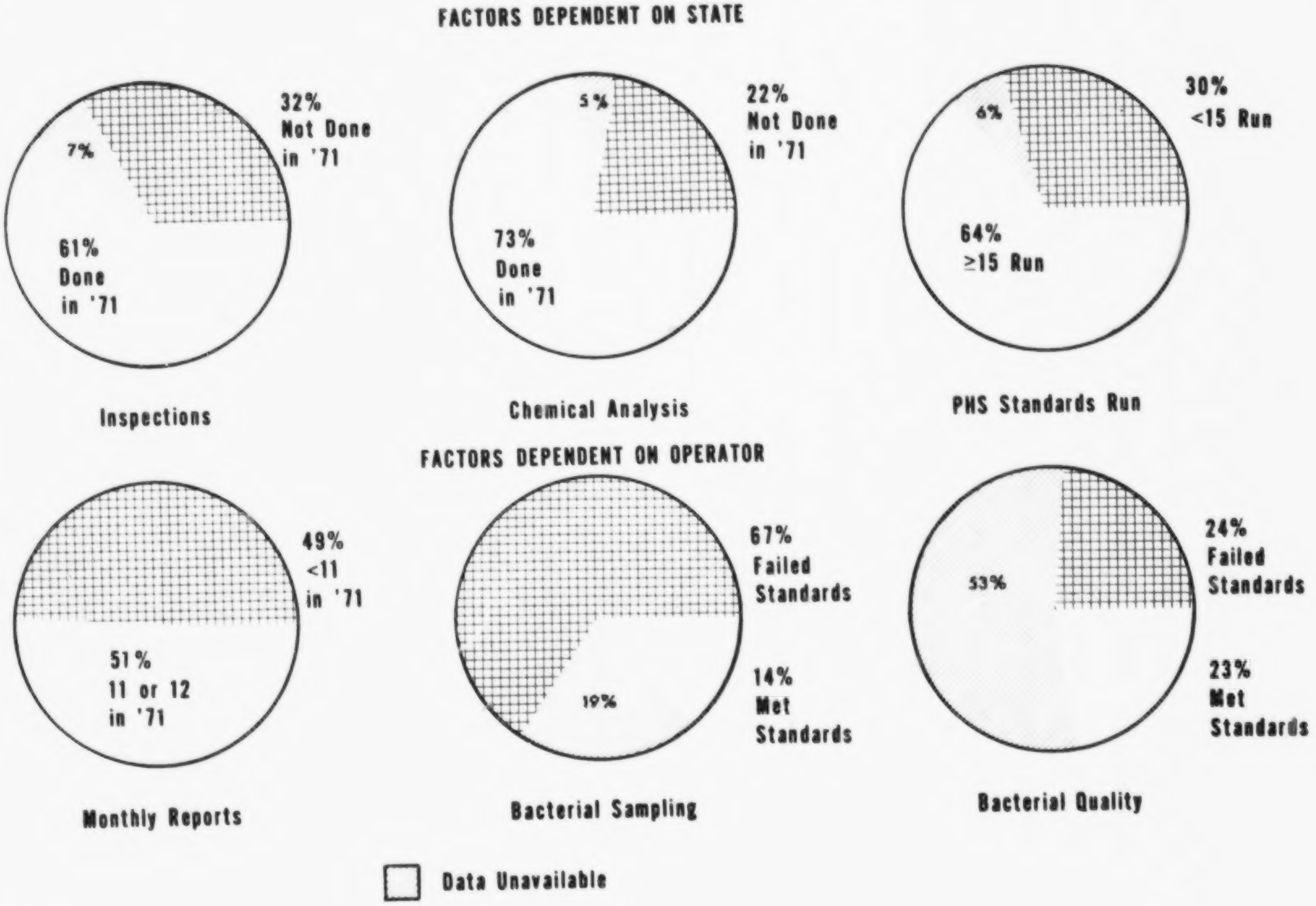


Figure 3
Community Water Supply Surveillance in Ohio

INSPECTIONS

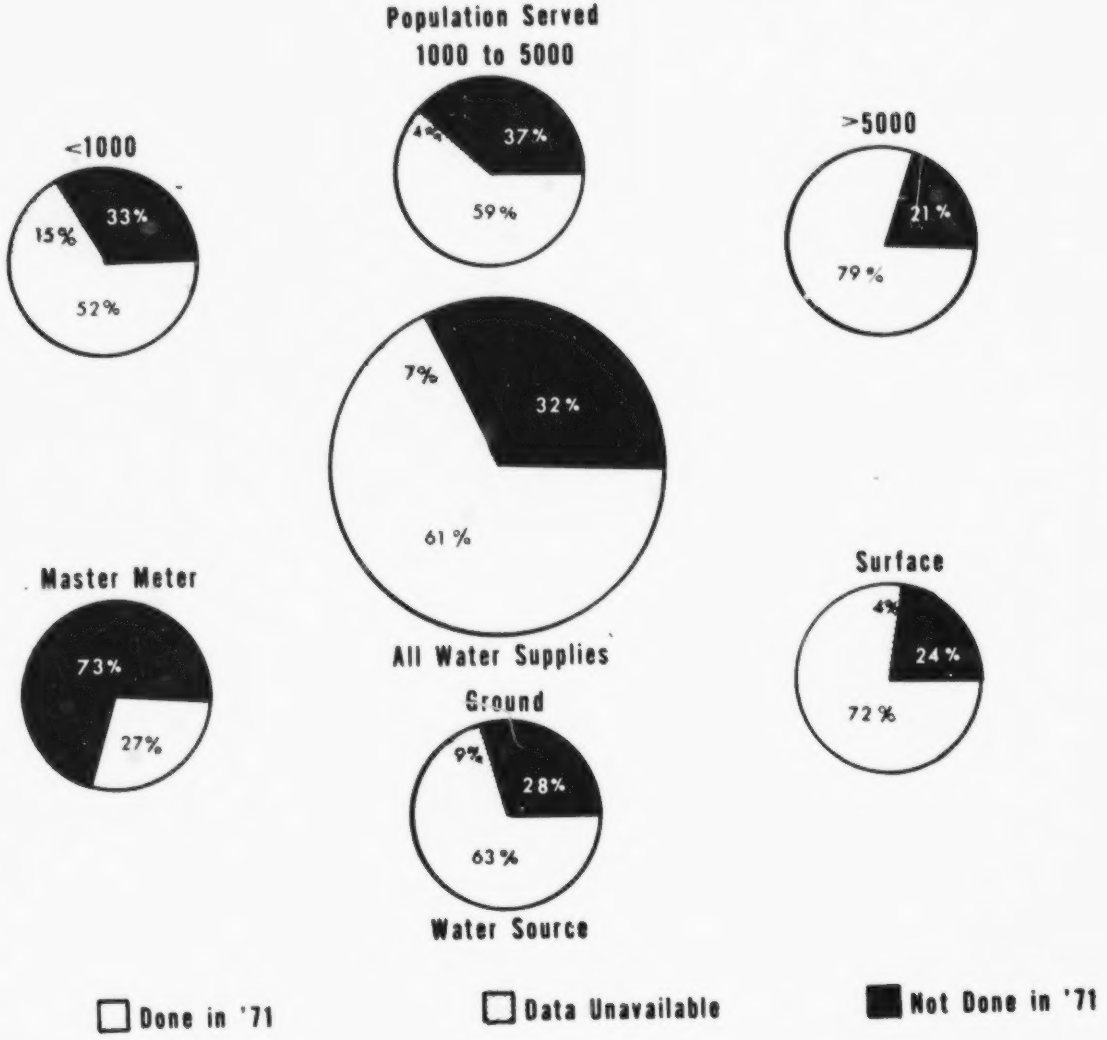


Figure 4
Community Water Supply Surveillance in Ohio

CHEMICAL ANALYSIS

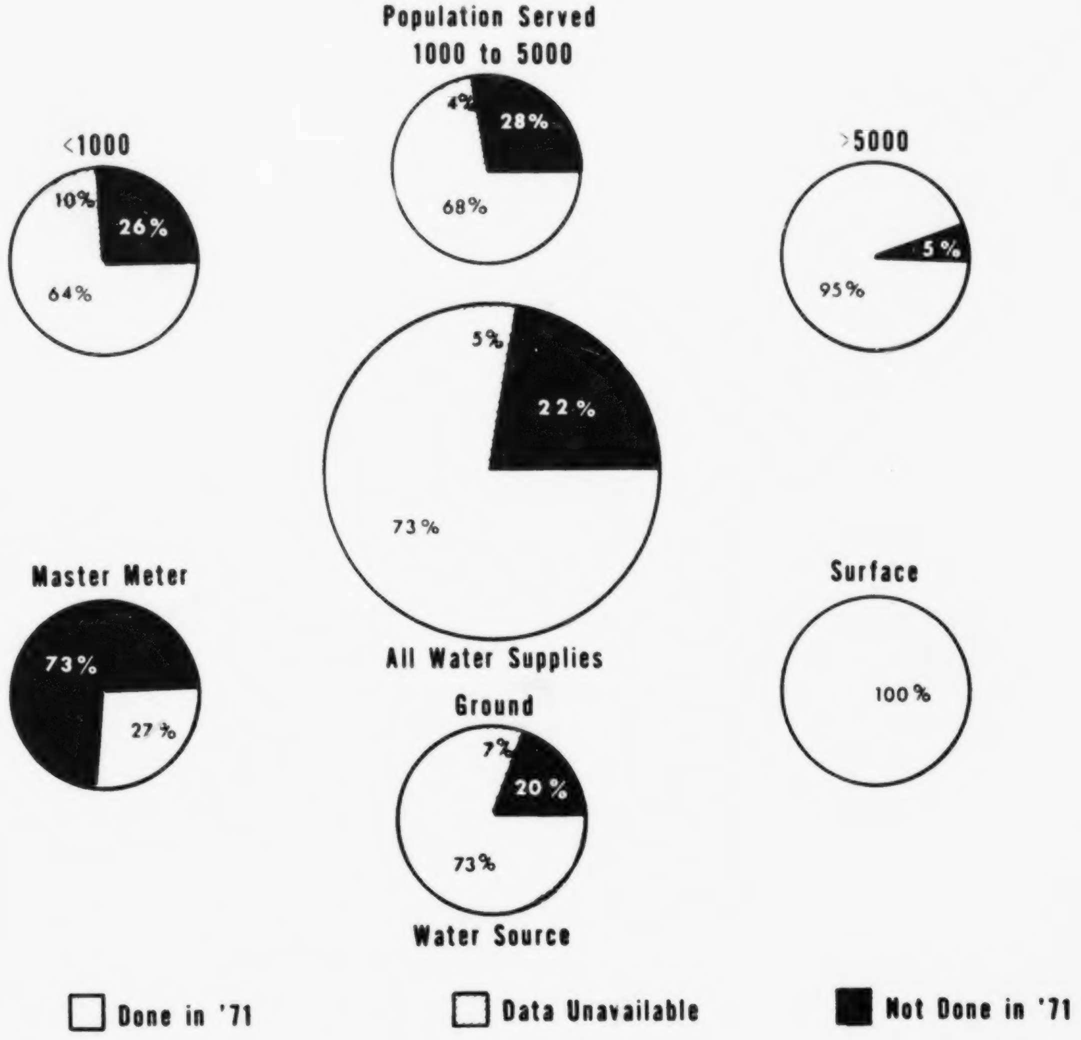


Figure 5
Community Water Supply Surveillance in Ohio

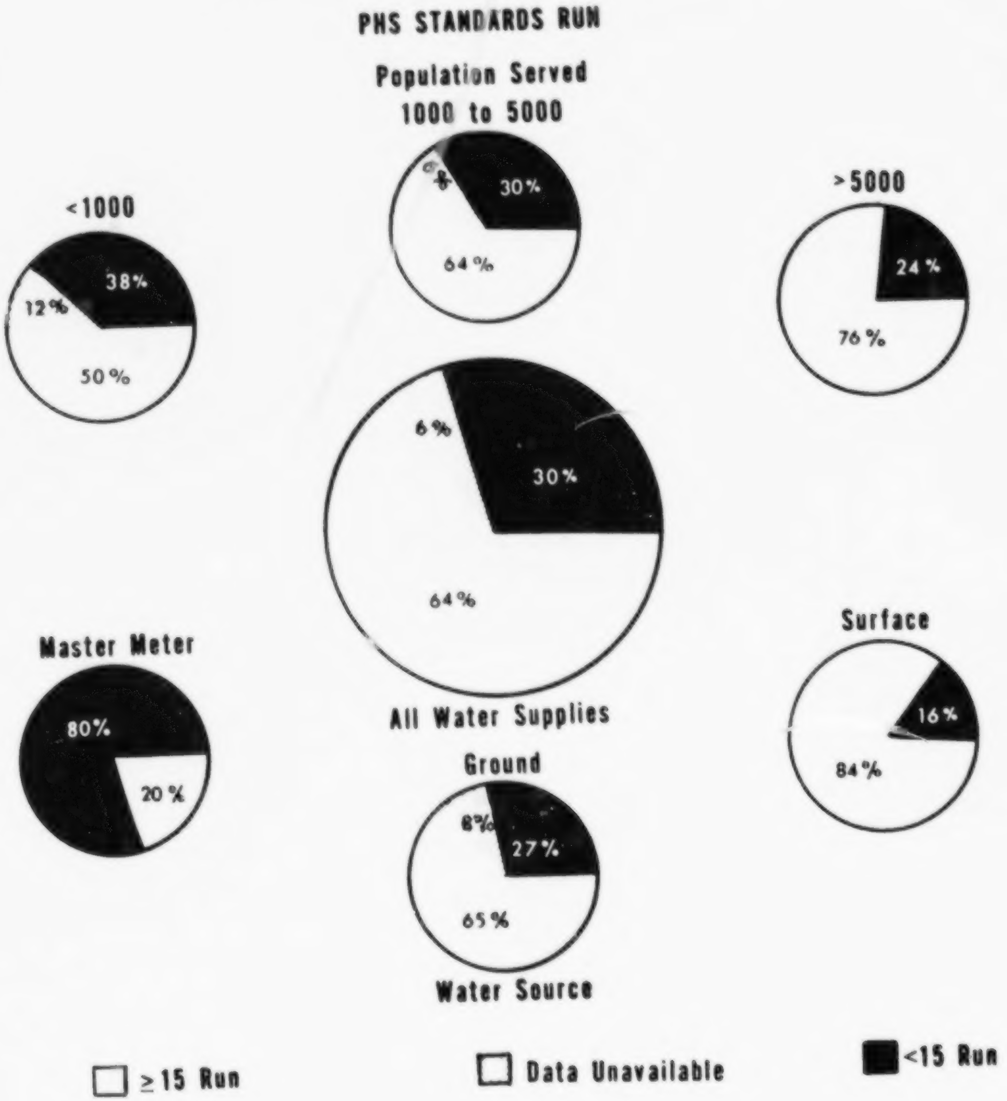


Figure 6
Community Water Supply Surveillance in Ohio

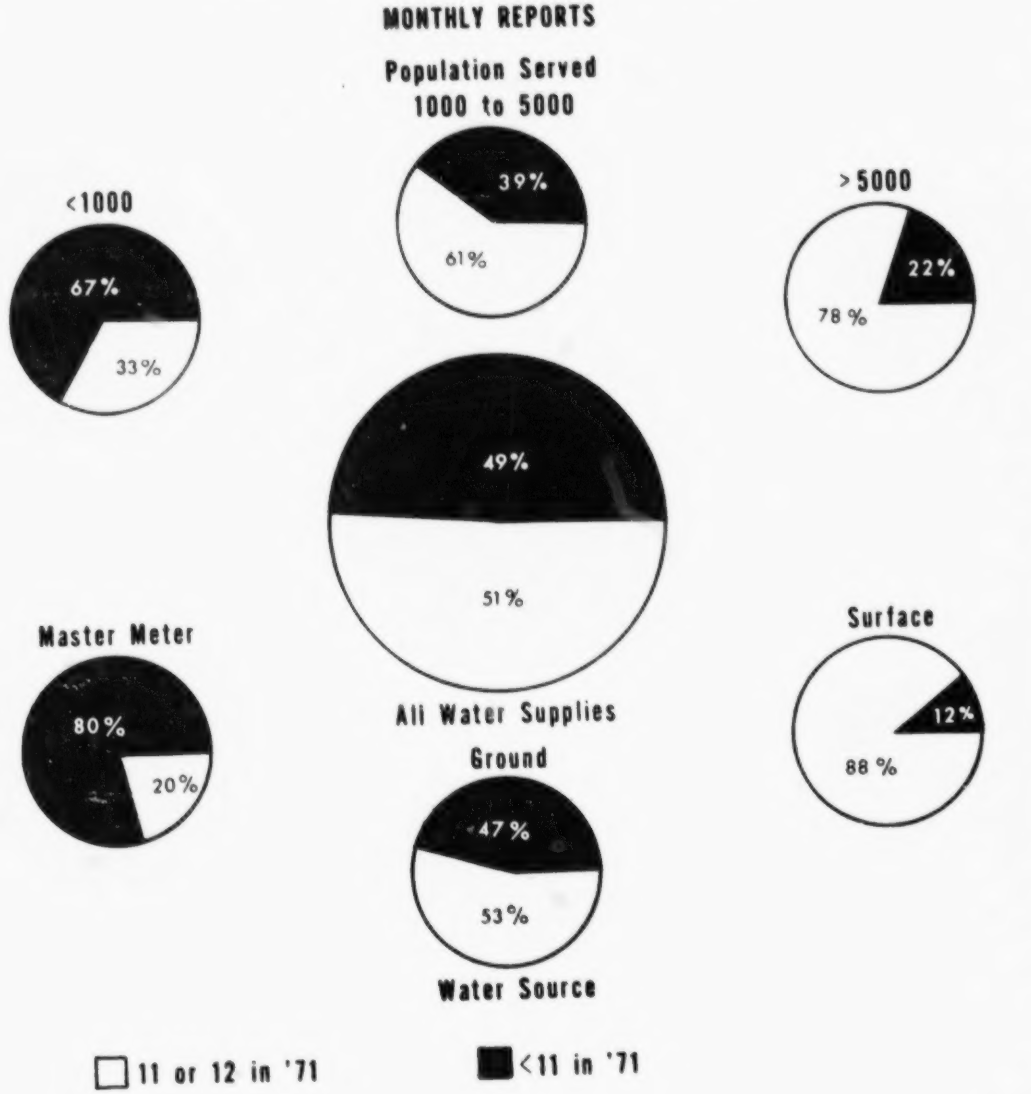


Figure 7

Community Water Supply Surveillance in Ohio

BACTERIAL SAMPLING

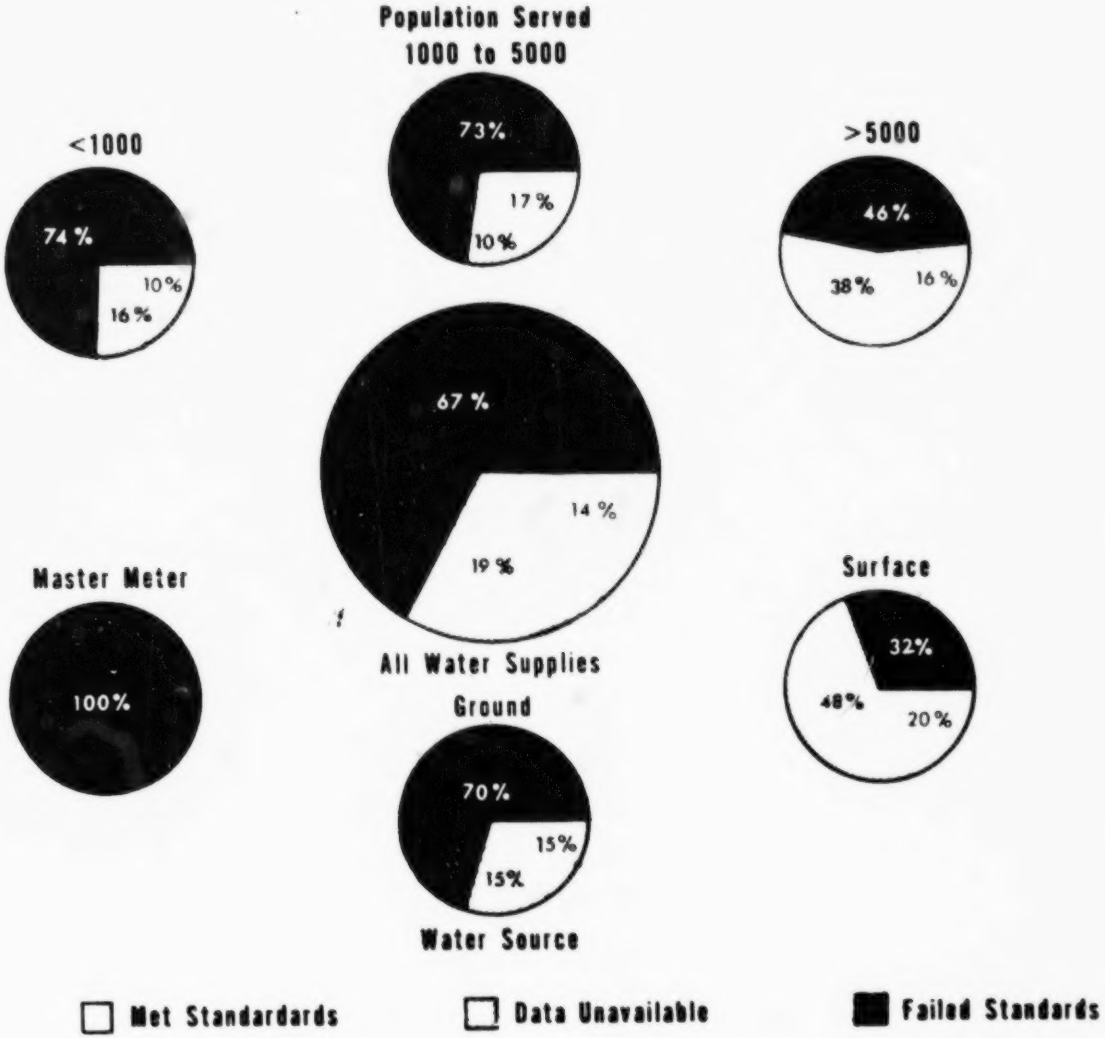


Figure 8
Community Water Supply Surveillance in Ohio

BACTERIAL QUALITY

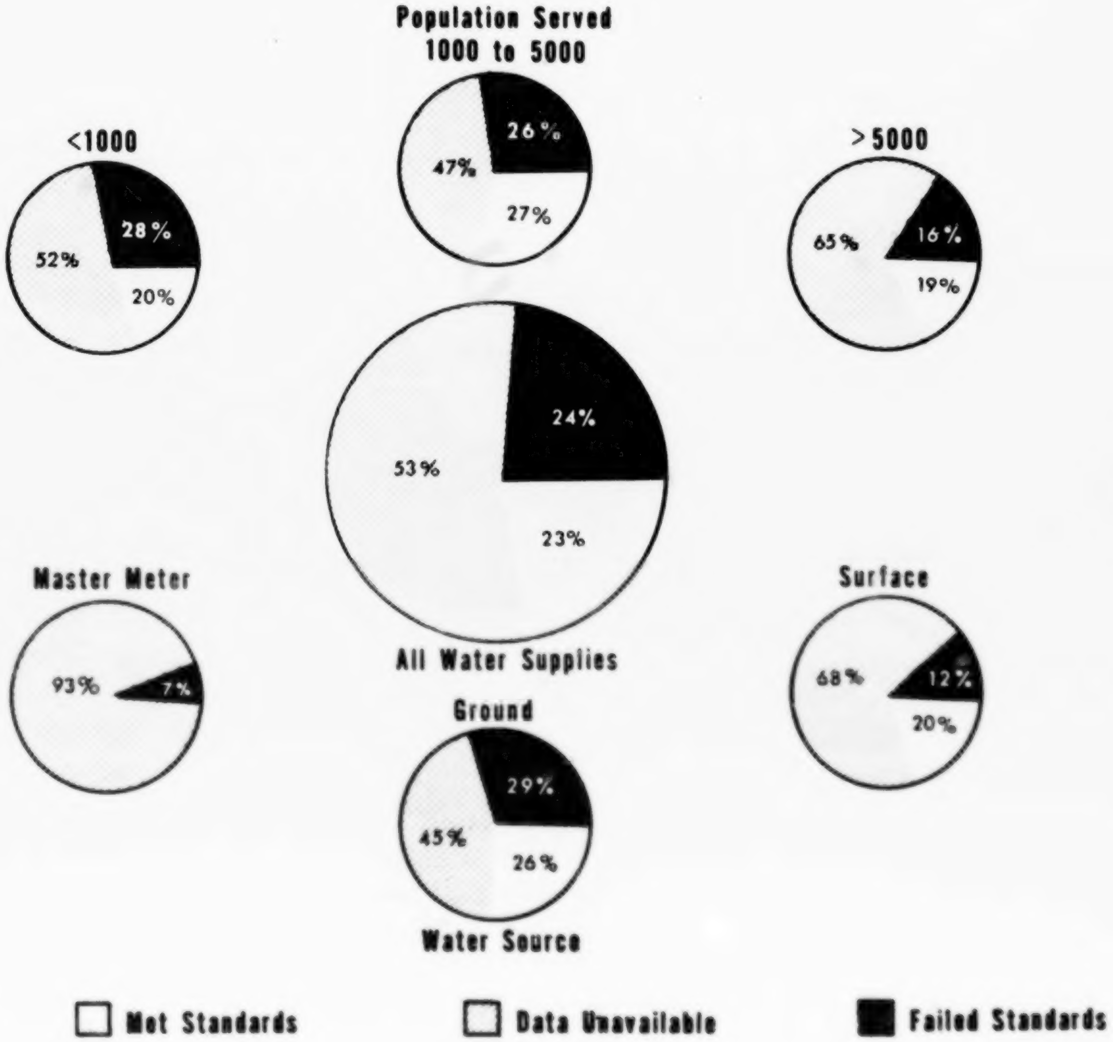


Figure 9 Inspection Record, 1971 by District by Population Served

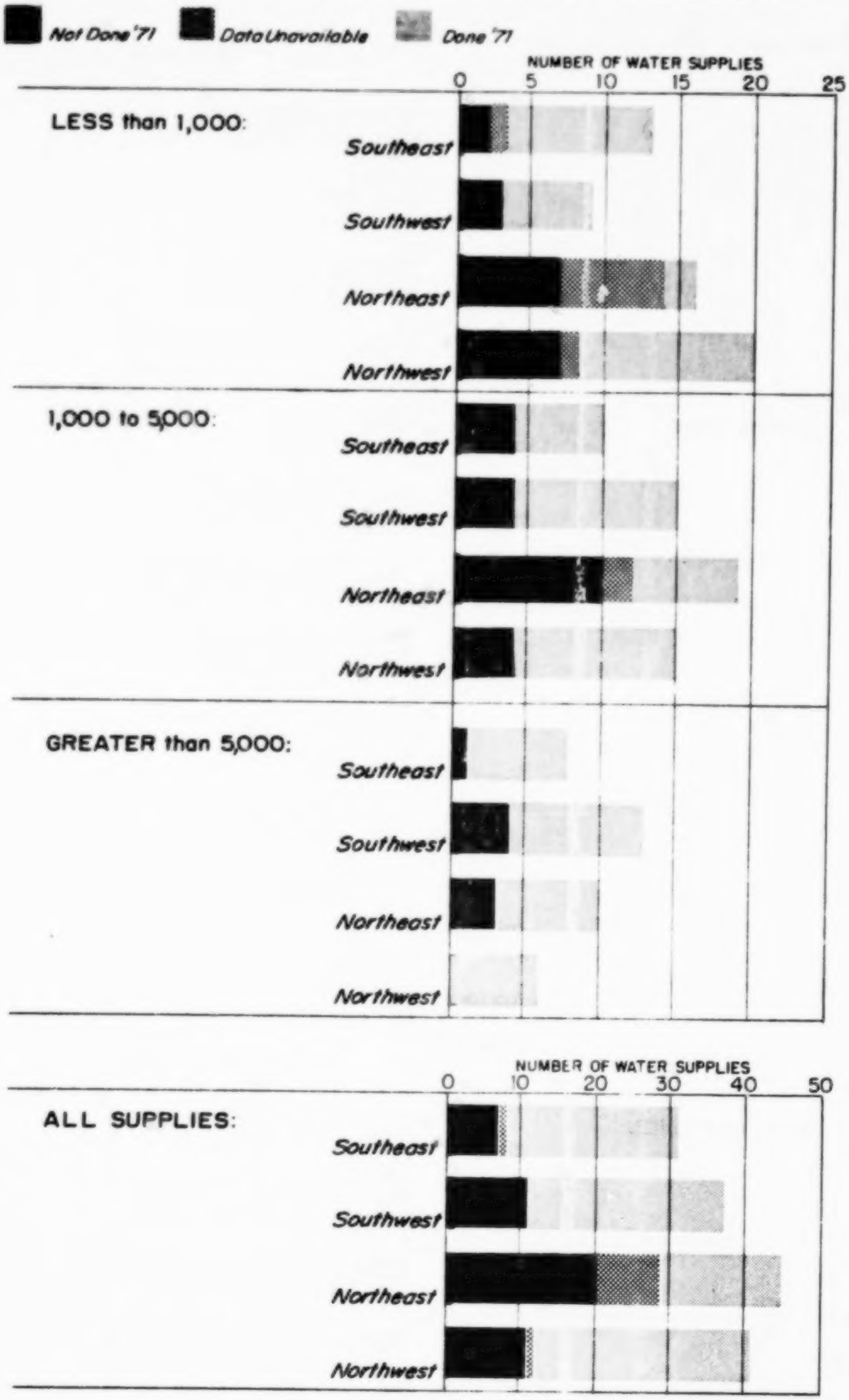


Figure 10 Chemical Analysis Record, 1971 by District by Population Served

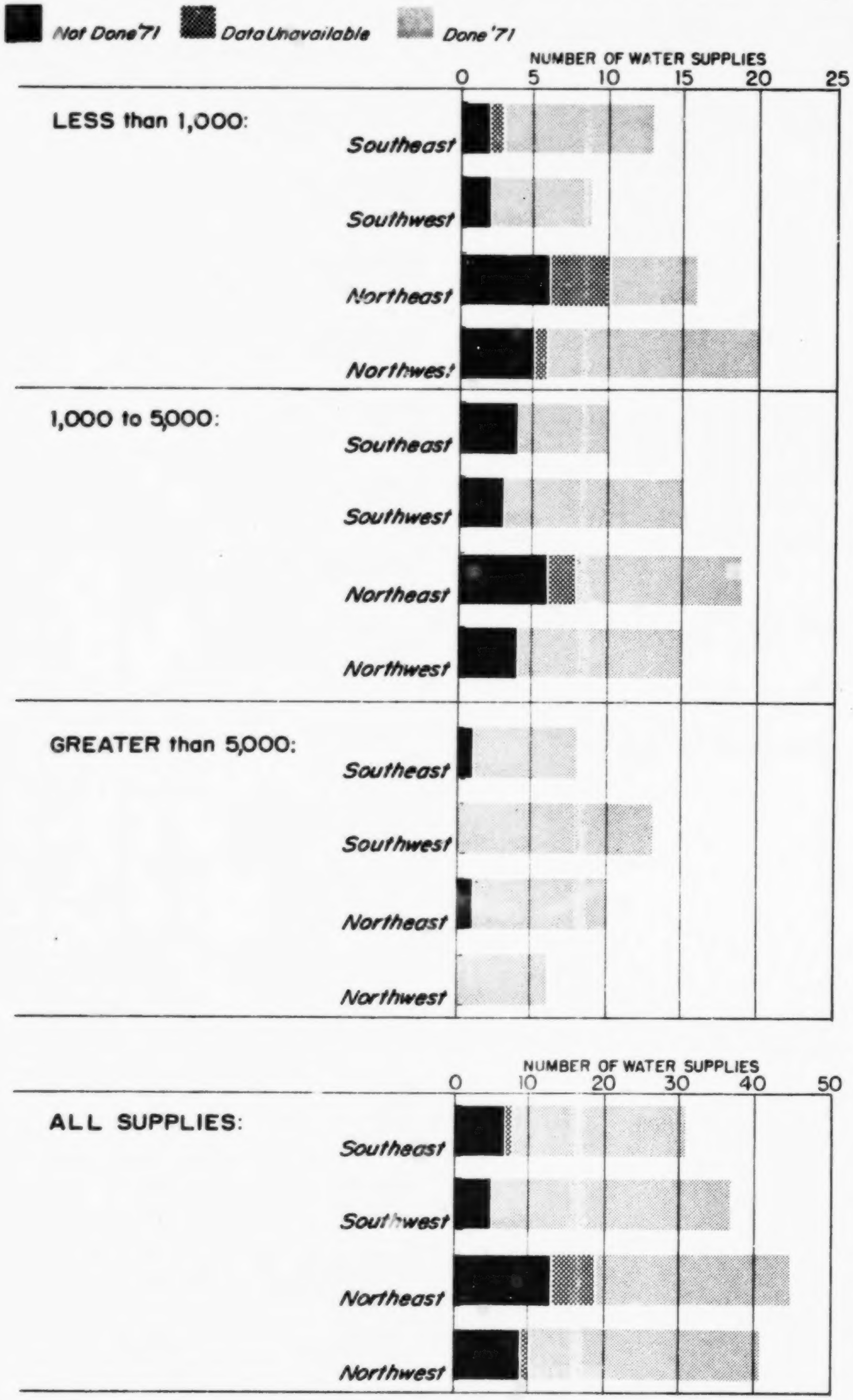
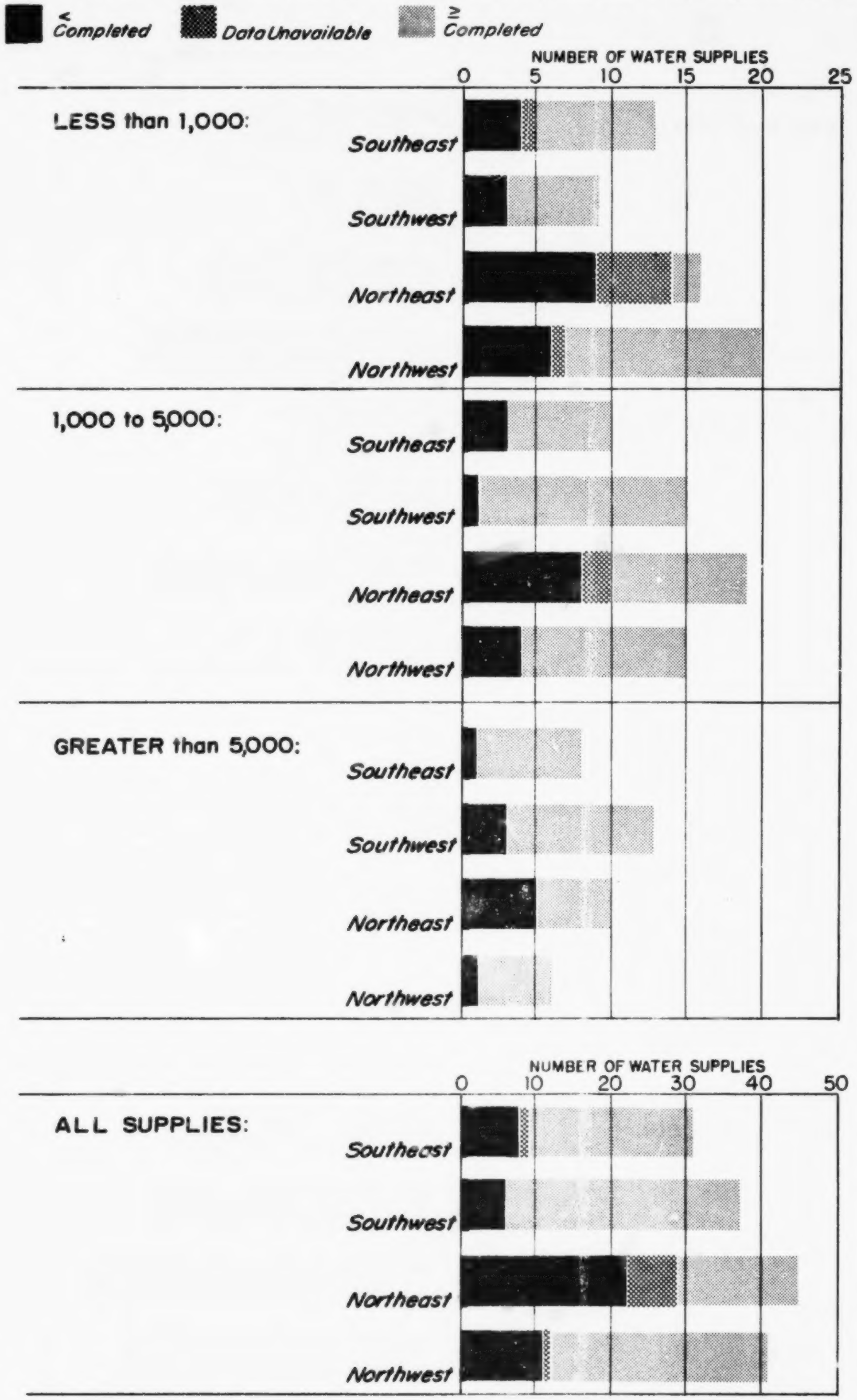


Figure 11 Public Health Service Standards Run by District by Population Served



Ohio Surveillance Program

Figure 12 Monthly Reports, 1971 by District by Population Served

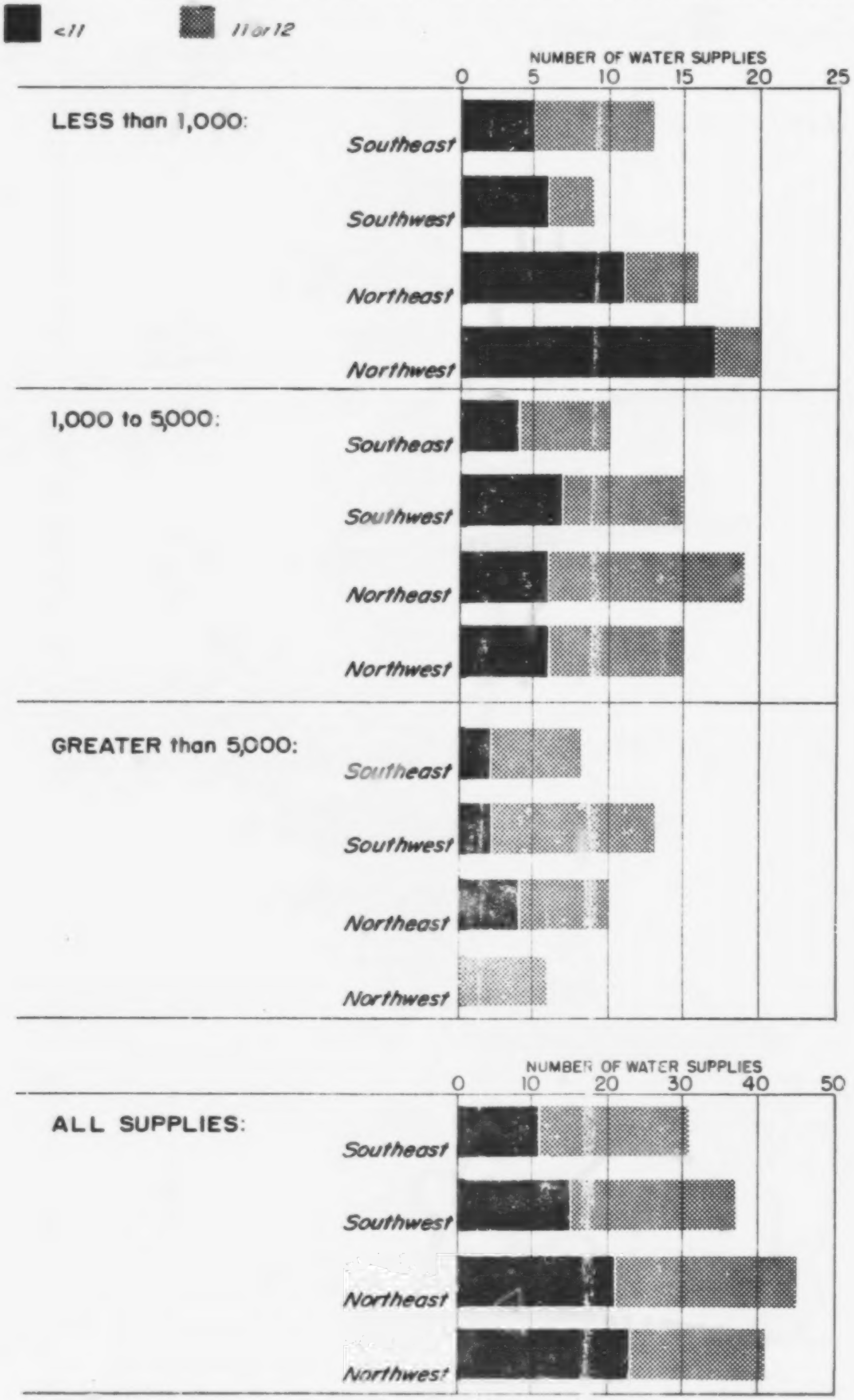
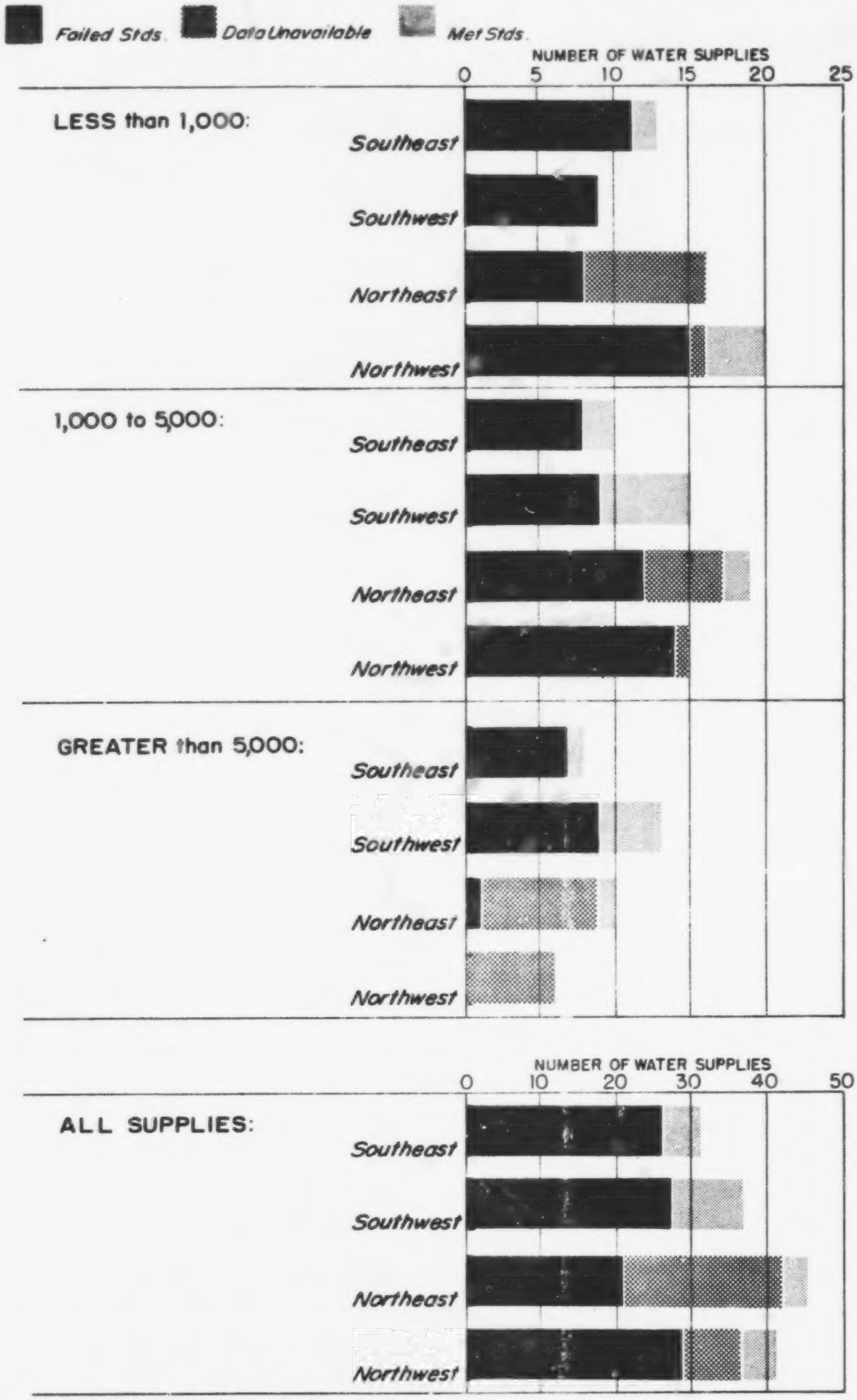
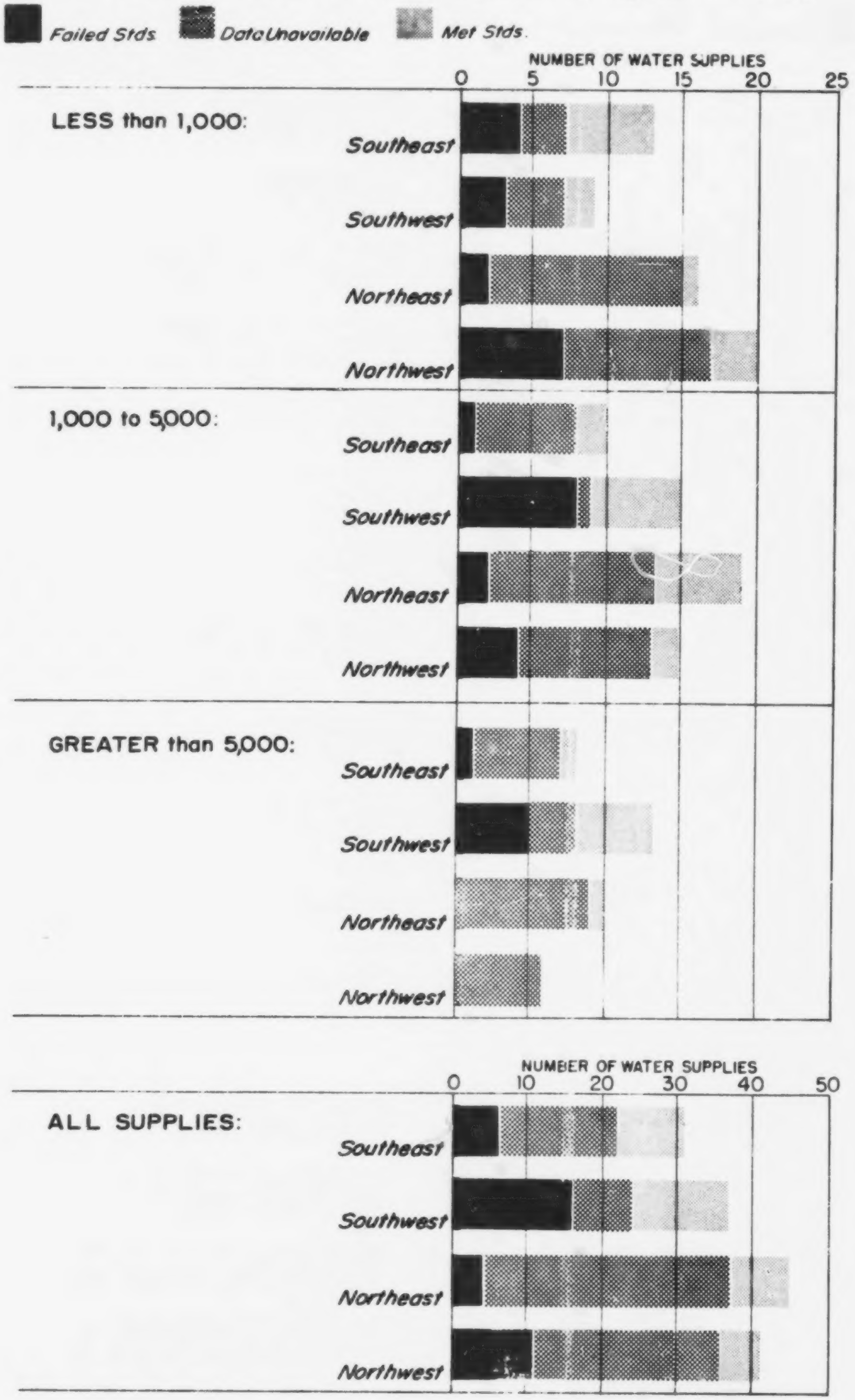


Figure 13 Bacterial Sampling Record, 1971 by District by Population Served



Ohio Surveillance Program

Figure 14 Bacterial Quality, 1971 by District by Population Served



to performance, show program emphasis and the status of records keeping. The Northeast District had very poor performance with 36 percent of the supplies inspected. The other Districts completed inspections on 70 or more percent. Program emphasis was placed on the larger supplies in the Northwest and Northeast Districts, on all supplies in the Southwest and on larger and smaller supplies in the Southeast. Record keeping was good except in the Northeast District where no records could be located on 44 percent of the small supplies or on 11 percent of the 1,000 - 5,000 population served supplies.

Chemical Analysis

Chemical analysis is necessary on a periodic basis to determine the absence of toxic and aesthetically undesirable chemicals and to detect any increases in the concentrations of such substances.

Figure 4 shows that the State provided chemical analyses for 73 percent of the community water supplies. All surface water supplies and 95 percent of the supplies serving more than 5,000 people were provided with analyses. Only 27 percent of the master-metered water supplies, however, were provided with such analyses.

Figure 10 indicates the performance by District and population class for this parameter. The data show that all Districts have practically complete chemical sampling for the greater than 5,000 population class. The performance for the other population classes varies from District to District. The Southwest District has practically complete chemical sampling records with 86 percent of the supplies sampled in 1971. The Northeast District shows poor performance with only 58 percent of the supplies sampled.

PHS Standards Run

The PHS Drinking Water Standards list 21 chemical, three physical, and three radiochemical parameters which are considered most likely to occur in water and for which standards have been established. In 1970, the Ohio Department of Health determined to obtain complete chemical data on community water supplies and expanded its analysis program to include 16 of the DWS parameters, plus 13 other parameters. This data is important to assuring that toxic chemicals are not present in significant concentrations and are not increasing in the State's community water supplies.

Figures 5 and 11 illustrate the degree of progress accomplished by the increased emphasis placed on chemical analysis. Sixty-four percent of the community water supplies reviewed had received chemical analyses under the State's new program. Emphasis placed on larger and surface water supplies resulted in 76 percent of the supplies serving more than 5,000 people and 84 percent of the surface water supplies having analyses made. Only 20 percent of the master-metered and 50 percent of the supplies serving fewer than 1,000 people were done.

As shown by Figure 11, few of the Northeast District supplies (35 percent) were provided with available analyses in 1971. The other Districts had much better records with 71, 76, and 84 percent of the supplies provided with available analyses.

Monthly Reports

Monthly reports provide the State with detailed data on the day-to-day operation of community water supplies. The analysis of such reports can indicate the development of operational problems and provide data on the status of community water supplies. Failure to provide such reports to the State indicates a failure of the water supply program to establish the need and value of such reports in the minds of the operators.

Figure 6 shows that 51 percent of the supplies report regularly to the State. This response of community water supply operators to the State water supply program varies appreciably depending on the size and source of the supply. Thirty-three percent of the supplies serving fewer than 1,000 people and 20 percent of the master-metered water supplies provided regular reports. On the other hand, 78 percent of the supplies serving more than 5,000 people, and 88 percent of the surface water supplies provided regular reports.

Figure 12 shows that performance varies from District to District for each population class. The basic pattern of better reporting for larger supplies generally applies, however, to each of the Districts. On an overall basis the Southwest District has the best record, with 59 percent reporting regularly. The other District records are somewhat poorer with 44, 48, and 53 percent reporting regularly.

Bacterial Sampling

The determination of bacterial quality is dependent on the collection and analysis of adequate numbers of bacterial samples. Failure to obtain adequate bacterial samples as specified by the DWS (Ohio Water Supply Program policy) makes the determination of bacterial quality impossible.

Figure 7 shows that 67 percent of the supplies failed to meet the sampling standards. Only 14 percent were known to meet the standards. The status of the remaining 19 percent was unknown due primarily to poor record keeping of non-State laboratory data. No master-metered water supply conducted adequate bacterial sampling. The percentage of supplies meeting the sampling standards for 11 or 12 months of 1971 is very low for all classes.

Figure 13 illustrates the data by population class and the entire sample for each District. Sampling performance is poor for all Districts. In addition, poor record keeping is noted for the Northeast and Northwest Districts. Of particular importance is the fact that even the greater than 5,000 class showed very poor compliance with the State's bacterial sampling requirements.

Bacterial Quality

Failure to meet bacterial quality standards indicates a serious potential health hazard and calls for prompt corrective action. Determination of safe bacterial quality is the primary surveillance mechanism used to assure the delivery of safe quality water.

Figure 8 demonstrates that bacterial quality consistently meeting the DWS was reported for only 23 percent of the community water supplies. Twenty-four percent failed the DWS one or more months in 1971. For the remaining 53 percent the bacterial water quality was unknown due to inadequate sampling and poor record keeping.

Figure 8 also shows the data divided into three population classes and three source classes. The large percentages of data unavailable for the greater than 5,000 and surface classes are due primarily to poor record keeping of data received from non-State laboratories. The large percentages of data unavailable for the 1,000, 1,000-5,000, ground, and master-meter classes are due primarily to inadequate sampling. Particularly striking is the small proportion of community water supplies for which bacterial quality was known to be consistently satisfactory.

Figure 14 provides a comparison of performance for the bacterial quality parameter on a District by District basis for the population served classes and the entire sample. Poor record keeping and inadequate sampling are indicated by data unavailable figures. The data show very poor record keeping and inadequate sampling for three Districts (52, 61, and 73 percent data unavailable). Where data was relatively complete, 43 percent of the supplies exceeded the bacterial quality standards one or more months in 1971.

Special Fluoridation Studies

Field Study

Data collected on the community water supplies fluoridating in the State of Ohio indicated 15 (94 percent) of the 16 installations selected for investigation evidenced a fluoride ion content in the distribution system at the time of the survey within the 0.8 - 1.3 mg/l range required by the State. One (six percent) of the facilities (Yellow Springs) was underfeeding, i.e. the fluoride ion level in the samples collected from the distribution system was less than 0.8 mg/l.

The operating conditions observed during the time of the survey of the 16 fluoridation installations inspected are summarized as follows:

1. Analytical Control of the Fluoride Ion Level

Practices to analytically test and control the fluoride ion level in the distribution systems varied considerably. Only six (38 percent) of the plant operators or laboratory personnel conducted fluoride ion analysis within ± 0.1 mg/l of the duplicate sample analysis performed by the EPA, Water Supply Division. Daily finished water fluoride ion analysis, required by the State Department of Health, was conducted at 11 (69 percent) of the installations and regular raw water fluoride ion analysis was being conducted at only nine (56 percent). Adequate analytical equipment and facilities were available, and care of equipment was judged satisfactory at 13 (81 percent) of the plants visited; however, one operator was not using one of the Standard Methods for fluoride ion analysis. Records of the fluoridation operation were acceptable at 14 (88 percent) of the facilities surveyed.

2. Fluoride Chemical Feed Equipment and Facilities

Fluoride chemical feed equipment and facilities were found deficient at three (19 percent) of the 16 installations surveyed and only 11 (69 percent) of the feeding arrangements were acceptable, i.e. protected against overfeeding, preferred point of chemical application, protected against backflow, and good housekeeping in the feeder area. Five (36 percent) of the installations in operation longer than one year were reported by the operators to have had one or more interruptions in fluoridation of one or more days duration in the past 12 months. Maintenance was judged satisfactory at 15 (94 percent) of the facilities surveyed.

3. Fluoride Chemical Compound - Storage and Handling

Storage arrangements for the fluoride chemical compound fed were unsatisfactory at seven (44 percent) of the 16 installations surveyed. Five (31 percent) of the operators interviewed did not have available suitable safety equipment to handle the fluoride chemical compounds; and two (12 percent) of the operators were permitting unsafe reuse of the chemical shipping containers or were not disposing of the empty containers satisfactorily.

4. Operator Training and Interest

A trained operator with a genuine interest in feeding fluorides is essential to the satisfactory operation of a fluoridation installation. (Special training courses were conducted in Ohio for the operators of the water supply systems required to fluoridate under the recently passed State Fluoridation Law - the effect of the training is discussed below.) Three (19 percent) of the facilities surveyed were operated by personnel not completely familiar with the fluoride chemical feed equipment at their plants. Three (19 percent) of the operators questioned were not adequately trained in the use of the fluoride ion test equipment provided and the procedures to follow in conducting a fluoride ion analysis. The operator at one (6 percent) of the plants visited did not favor feeding fluoride to public water supply systems.

5. Surveillance

Frequent check samples of fluoride ion levels in the distribution system and regular inspection visits to the water fluoridation installation by State water supply surveillance personnel must be conducted to assure the facility is operating. The State Department of Health's requirement is for one water sample per month to be collected from the distribution system of fluoridated water supplies and submitted to the State Laboratory for fluoride ion analysis. A review of State Laboratory records for 1971 revealed the required monthly check samples had not been received from six (37 percent) of the installations selected for survey. Fourteen (88 percent) of the 16 plants had been visited in the past 12 months by a representative of the State Department of Health's water supply surveillance agency. Inspection visits to the water supply systems surveyed averaged one visit in six months.

Table 4, Operating Conditions at Selected Fluoridated Water Supply Systems, summarizes the operating conditions observed at the installations inspected during the time of the survey. Table 5, Adequacy of Fluoridation at Selected Water Supply Systems, summarizes the adequacy of the operating

Table 4

Operating Conditions at Selected Fluoridated Water Supply Systems in Ohio

Parameter Evaluated	Percent of Fluoridated Water Supply Systems Surveyed
Fluoride Ion Content in the Distribution System	
Fluoride Ion Level 0.8 - 1.3 mg/l	94%
Fluoride Ion Level <0.8 mg/l	6%
Fluoride Ion Level >1.3 mg/l	
Analytical Control of the Fluoride Ion Level	
Operator Analysis ± 0.1 mg/l EPA Value	38%
Daily Finished Water Fluoride Ion Analysis	69%
Regular Raw Water Fluoride Ion Analysis	56%
Adequate Analytical Equipment & Facilities	81%
Adequate Care for Laboratory Equipment	81%
Adequate Records	88%
Fluoride Chemical Feed Equipment & Facilities	
Adequate Feeding Equipment & Facilities	81%
Adequate Feeding Arrangements	69%
Feed Interrupted <1-Day in Past 12 mos.*	64%
Adequate Maintenance	94%
Fluoride Chemical Compound - Storage & Handling	
Adequate Storage Arrangements	56%
Acceptable Safe Handling Provisions	69%
Satisfactory Disposal of Shipping Containers	88%
Operator Training and Interest	
Adequately Trained to Operate Feed Equipment	81%
Knowledge of Test Equipment & Procedures	81%
Accepts and Interested in Fluoridation	94%
Surveillance	
Monthly Check Samples to State**	63%
Installation Inspected by State in Past 12 mos.	88%

* 14 Installations Rated. Kent & Sidney Started Fluoridating 4/71 and 7/71, respectively.

** Per 1971 State Health Department Records

Table 5

Adequacy of Fluoridation at Selected Water Supply Systems in Ohio

Parameter Evaluated	Bowling Green	Defiance*	Huron	Vermilion*	Alliance	Cleveland	Kent*	Wellington	Glendale*	Hamilton	Sidney*	Yellow Springs*	Ironton*	Wellston	Westerville	Zanesville*
Fluoride Ion Content in the Distribution System																
(1) Fluoride ion level 0.8 - 1.3 mg/1	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X
Fluoride ion level <0.8 mg/1												X				
Fluoride ion level >1.3 mg/1																
Analytical Control of the Fluoride Ion Level																
(2) Operator analysis ± 0.1 mg/1 EPA value										X	X		X	X	X	X
(3) Daily finished water fluoride ion analysis		X	X	X	X	X	X	X	X			X	X			X
(4) Regular raw water fluoride ion analysis	X	X		X	X	X	X	X		X						X
(5) Adequate analytical equipment & facilities		X	X	X	X	X		X		X	X	X	X	X	X	X
(6) Adequate care for laboratory equipment	X	X	X	X	X		X	X		X	X	X		X	X	X
(7) Adequate records	X	X	X	X	X	X	X	X	X	X	X		X	X		X
Fluoride Chemical Feed Equipment & Facilities																
(8) Adequte feeding equipment & facilities	X	X	X		X		X	X	X	X	X	X	X		X	X
(9) Adequate feeding arrangements	X	X	X		X	X	X			X	X		X		X	X
(10) Feed interrupted <1 day in past 12 mos.	X	X	X		X		1/	X	X	X	2/				X	X
(11) Adequate maintenance	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X
Fluoride Chemical Compound - Storage & Handling																
(12) Adequate storage arrangements	X	X	X	X			X				X	X	X			X
(13) Acceptable safe handling provisions	X	X		X	X		X	X	X	X	X		X			X
(14) Satisfactory disposal of shipping containers	X	X	X		X	X	X	X		X	X	X	X	X	X	X
Operator Training and Interest																
(15) Adequately trained to operate feed equipment	X	X	X		X	X	X	X		X	X		X	X	X	X
(16) Knowledgeable of test equipment & procedures		X	X	X	X	X		X		X	X	X	X	X	X	X
(17) Accepts and interested in fluoridation	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X
Surveillance																
(18) Monthly check samples to State 3/	X	X	X	X	X				X		X	X	X			X
(19) Installation inspected by State in past 12 mo.	X	X	X	X	X	X	X		X	X	X		X	X	X	X

X - Satisfactory or applicable for system surveyed
* - Representative attended Fluoride Determinations in Water training course
1/ - Fluoridation started April 1971
2/ - Fluoridation started July 1971
3/ - Per 1971 State Health Department records

conditions observed at each facility during the time of the survey.

Evaluation of Operator Training

Eight (50 percent) of the 16 installations selected for survey had a representative attend one of the four Environmental Protection Agency's "Fluoride Determinations in Water" training courses conducted in Fiscal Year 1971 for Ohio water plant operators. Comparing the operating conditions of the installations surveyed in Ohio with the operating conditions of 68 installations surveyed in six other States (Table 6) reveals the Ohio installations were decidedly better. Ninety-four percent of the fluoridated supplies in Ohio had a fluoride ion content in the distribution system within the State recommended range, compared to only 43 percent of the fluoridated supplies surveyed in the other six States. The average increase for each of the parameters evaluated was 16 percent. This is a reflection of both a more comprehensive fluoridation control program in Ohio and attendance at the training courses.

Further comparison of the data for the supplies in Ohio which received EPA training versus the data for the supplies in Ohio which did not receive EPA training (Figure 15) reveals less significant variation of performance attributable to the training courses. The supplies receiving training provided more frequent checks of fluoride content, practiced better fluoride chemical handling and storage, and were more dependable in providing check samples to the State. Supplies not receiving training practiced better fluoride chemical container disposal and were better trained to operate feed equipment. Figure 15 does point out several areas in which training is lacking.

Table 6

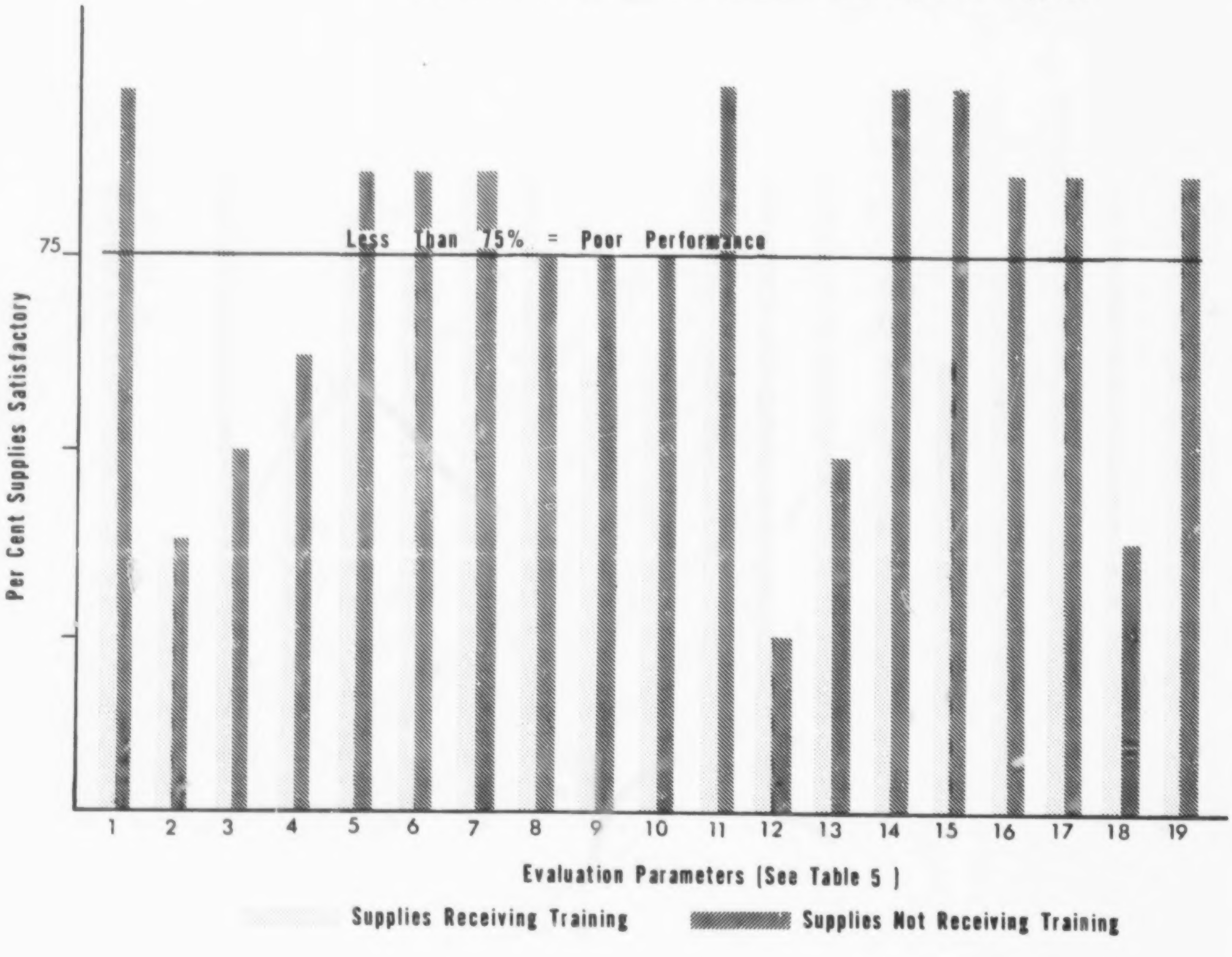
Comparison of Operating Conditions at Fluoridation Installations in Ohio and Six Other States

Parameter Evaluated	Percent of Fluoridated Water Supply Systems Surveyed	
	Ohio	Six Other States
Fluoride Ion Content in the Distribtion System		
Fluoride Level Within Recommended Limits*	94%	43%
Analytical Control of the Fluoride Ion Level		
Operator Analysis ± 0.1 mg/l EPA Value	38%	44%
Daily Finished Water Fluoride Ion Analysis	69%	65%
Regular Raw Water Fluoride Ion Analysis	56%	38%
Adequate Analytical Equipment & Facilities	81%	78%
Adequate Care for Laboratory Equipment	81%	67%
Adequate Records	88%	62%
Fluoride Chemical Feed Equipment and Facilities		
Adequate Feeding Equipment and Facilities	81%	57%
Adequate Feeding Arrangements	69%	40%
Feed Interrupted <1 Day in Past 12 months	64%	71%
Adequate Maintenance	94%	56%
Fluoride Chemical Compound - Storage and Handling		
Adequate Storage Arrangements	56%	63%
Acceptable Safe Handling Provisions	69%	51%
Satisfactory Disposal of Shipping Containers	88%	77%
Operator Training and Interest		
Adequately Trained to Operate Feed Equipment	81%	84%
Knowledge of Test Equipment & Procedures	81%	75%
Accepts and Interested in Fluoridation	94%	66%
Surveillance		
Check Samples to State as Required	63%	58%
Installation Inspected by State in Past 12 mos.	88%	43%

* Fluoride limits recommended by State concerned

Figure 15

Performance of Fluoridation at Selected Community Water Supplies



Evaluation of Fluoridation Records

Evaluation of past fluoridation data reported (November 1968 - October 1971) shows that community water supplies in Ohio which reportedly fluoridate produce water with a fluoride content between 0.7 and 1.5 mg/l about 95% of the time. About 90% of the supplies which reportedly fluoridate consistently produce water with a fluoride content between 0.7 and 1.5 mg/l.

Discussion

Public Water Supply Law, Regulations, and Policy

The Ohio legislature has established a number of general laws regarding public water supply. These laws are summarized below in the order of their importance to surveillance. Each law is also given a title to facilitate reference to the law later in the text.

General Supervision, Section 6111.13, states the Department of Health shall exercise general supervision of the operation and maintenance of public water supplies and water works systems throughout the State. Control over all features of construction, operation and maintenance of systems for supply treatment, storage and distribution which do or may affect the sanitary quality or fluoride content of the supplies is specified. A fluoride content of 0.8 to 1.3 ppm is required of water supplies serving 5,000 or more people as of January 1, 1972.* The State may reimburse the cost of installing fluoridation equipment upon request by the municipality and verification of proper facility installation by the Department. It is further specified that the Department shall investigate the public water supplies throughout the State as frequently as deemed necessary by the Department and whenever requested by local health officials. The Department may adopt and enforce orders and regulations governing construction, operation and maintenance and may require plans and descriptions of existing works.

---

* Fifty-six supplies required to fluoridate had not done so by January 1, 1972.

Plan Review, Section 3701.18, states that plans for provision, installation, or changes of water supply facilities must be approved by the Department. The only exceptions to this law are private residences or dwellings, and industrial water supplies not intended for human consumption.

Laboratory Service, Section 3701.22, provides that the Department may maintain a laboratory for chemical and bacterial examination of public water supplies. This section further states that the Department shall examine and report each year the condition of all public water supplies.

Analyses Required, Section 6111.14, states every public water supply shall have analyses of the water made at such intervals and in such manner as may be ordered by the Department. Records of results of analyses shall be maintained and reported as required by the Department.

Private, Auxilliary, or Emergency Water Supply Connections, Section 6111.15, provides that such connections to a public water supply shall be approved by the Department.

Improvement Orders, Section 6111.20, provides for orders to the mayor or managing officials of a water supply not producing water of reasonable quality, due to incompetent supervision or inefficient operation, to secure operation producing water of reasonable quality.

Water Supplies Operated for Profit, Section 4905, establishes a Public Utilities Commission which governs water supply utilities operated for profit. Section 4933.25 provides that a certificate of public convenience and necessity must be obtained from the Commission before such a water supply utility can be established or expand its operation.

Local Health Department or Township Trustees Complaint, Section 6103.17, states that on written complaint from local health departments or township trustees the Department must investigate conditions and may order improvement.

Water Supply Contracts, Sections 6103.20 - .24 provides that boards of county commissioners may contract to provide water to consumers outside sewer districts. These sections also provide that counties and municipalities may contract with one another for the provision of water supply with the approval of the Department.

Enforcement procedures for 6111.13, .14 and .15 are defined in 6111.16, .17, .18, .19, .20, .21, .23, .24, .25, .26, .27, .30, and .99. These procedures call for notice to owner, public health council hearing, order for improvement, referee appeal, supreme court appeal, and $500 fine for noncompliance. Enforcement for 3701.18, 3701.22, and 6111.13, .14, and .15 must be instituted by the Director of Health as specified by Section 3701.57. Violations of 3701.18 are punishable by fines of not less than $100 nor more than $500 and/or 90 days in prison. Violations of 6111.13, 6111.14 and 6111.15 are punishable by fines of not more than $500.

The law in the Plan Review Section defines water supplies for which plans are required as being all water supplies serving buildings or places except those serving a private residence and those intended for industrial use not including human consumption. The General Supervision Section defines public water supplies, for which general supervision of the operation and maintenance is required, as any system of public or quasi-public nature installed for an area or for buildings or places used for the assemblage or employment of people.

Water Supply Regulations are prepared by the Department of Health under Section 3701.03 of the State Law for consideration by the Public Health Council. Section 3701.33 of the State Law establishes a seven member, governor-appointed, Public Health Council which makes and amends sanitary regulations to be of general application throughout the State. The development of Rules and Regulations pertinent to water supply is assigned to the Water Supply Unit, the General Engineering Unit and the Division of Sanitation. Two regulations, HE-33, Plans Review and HE-37, Operator Certification relate to public water supply.

HE-33 refers to the submission of plans for water supply. Interconnections of public water supplies and other supplies are prohibited unless specifically approved by the Department. Plans must be in duplicate; accompanied by specifications, an engineering report and a request for approval; and approved by appropriate local officials. Additional data or plans may be required as well as revisions or alterations if the plans are considered to be unclear or inadequate. Design standards are not specified.

HE-37 provides for the mandatory certification of operators of water supply works serving a population of over 250 people. Where a full time certified operator cannot by obtained, a certified operator in responsible charge may be approved for a designated period of time by the Director. Water supply works are divided into four classes.

Examination for certification and prerequisites for examination are specified. "Grandfather" certificates were allowed only for those individuals operating a treatment plant prior to the regulation and are only good for the treatment plant operated. An advisory board of examiners is established to administer the certification regulation. Reciprocity with equivalent certifications in other States is established.

In addition to the State Law and Water Supply Regulations, an in-house Water Supply Committee appointed by the Chief Engineer of the Department prepares policy and guidelines for consideration by the Chief Engineer. The Water Supply Committee consists of one representative from each District Engineering Office, the Plan Review Section, the Operations Section, and the General Engineering Unit. Policies proposed by this committee cover both community and semi-public water supplies. Present established policies are with regard to:

1. Mandatory disinfection of public water supplies.
2. Ground Water Policy
3. Surface Water Policy
4. Waste Sludge and Filter Washwater Disposal

Policy has also been established by practice and application. Examples of these policies are the use of the Ten State Standard for plans review and reference to the Public Health Service Drinking Water Standards in monitoring of water quality. Such policies, however, have no official standing.

Department of Health Public Water Supply Program Organization

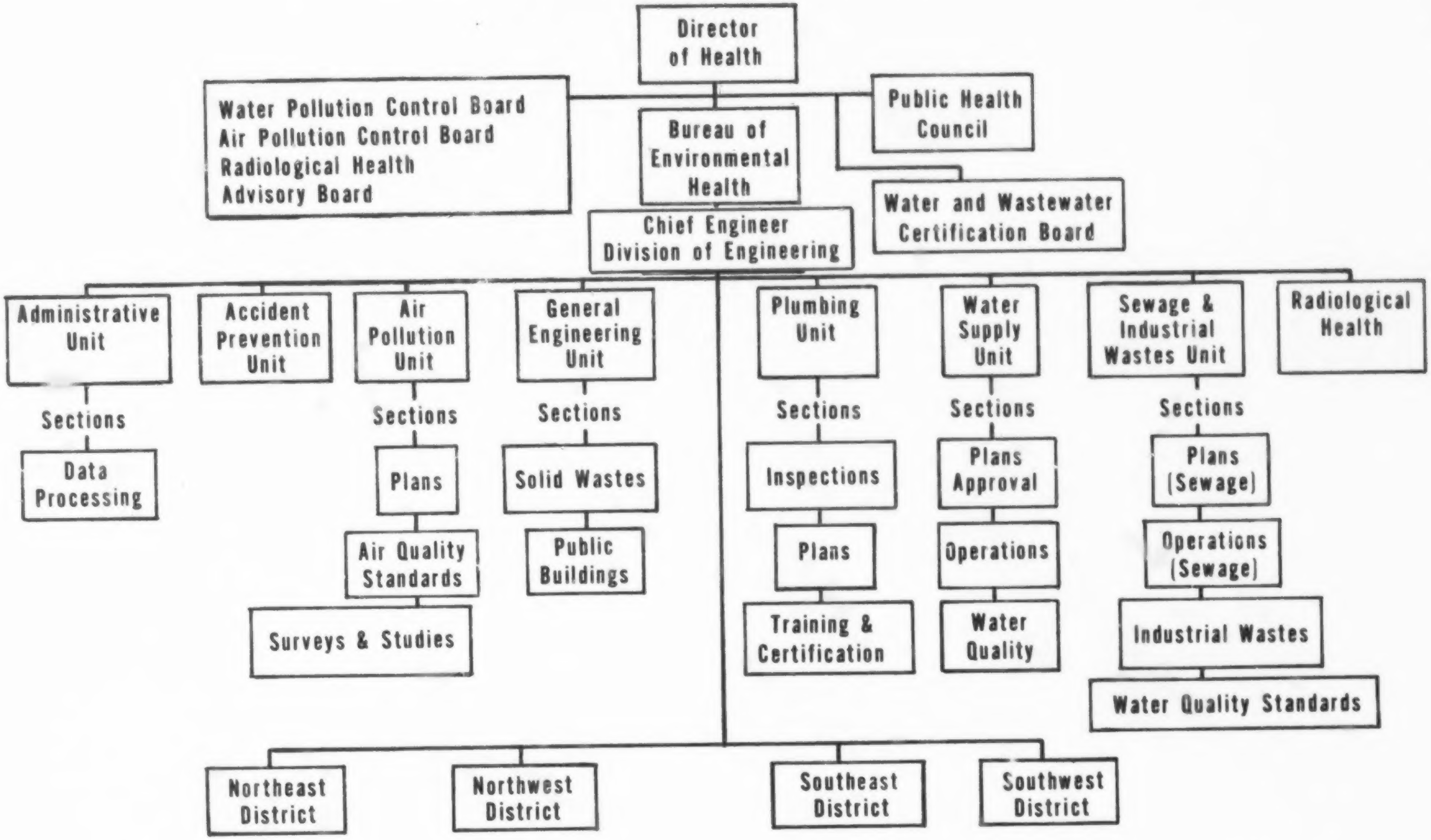
The Ohio Department of Health administers the State public water supply surveillance program with the authorizations of the General Supervision (Section 6111.13), Plan Review (Section 3701.18), Laboratory Service (Section 3701.22), and Analyses Required (Section 6111.14) Laws. In administering these laws, the Department of Health divides public water supplies into two classes, community water supplies and semi-public water supplies (see definitions in the "Water Supply Definitions" section in the Introduction of this report).

Community Water Supply Program

The community water supply program is conducted by the Water Supply Unit and the District Offices of the Division of Engineering (Figure 16). The Water Supply Unit organization is shown in Figure 17. Policy and program direction are established by the Chief, Division of Engineering, using information provided by the Water Supply Unit. The Water Supply Unit maintains records on all community water supplies, publishes inventories and other data summaries, provides direction to the District Offices on the conduct of inspections, provides technical assistance as available and upon request, provides staff work for the Water and Wastewater Operators Certification Committee, takes part in the Operators Training Committee of Ohio activities, conducts plans review, directs chemical and bacterial quality surveillance with the cooperation and assistance of the Bureau of Public Health Laboratories, and directs the fluoridation program. The District Offices are responsible for maintaining direct surveillance over the community water supplies within their areas of jurisdiction.

Figure 16

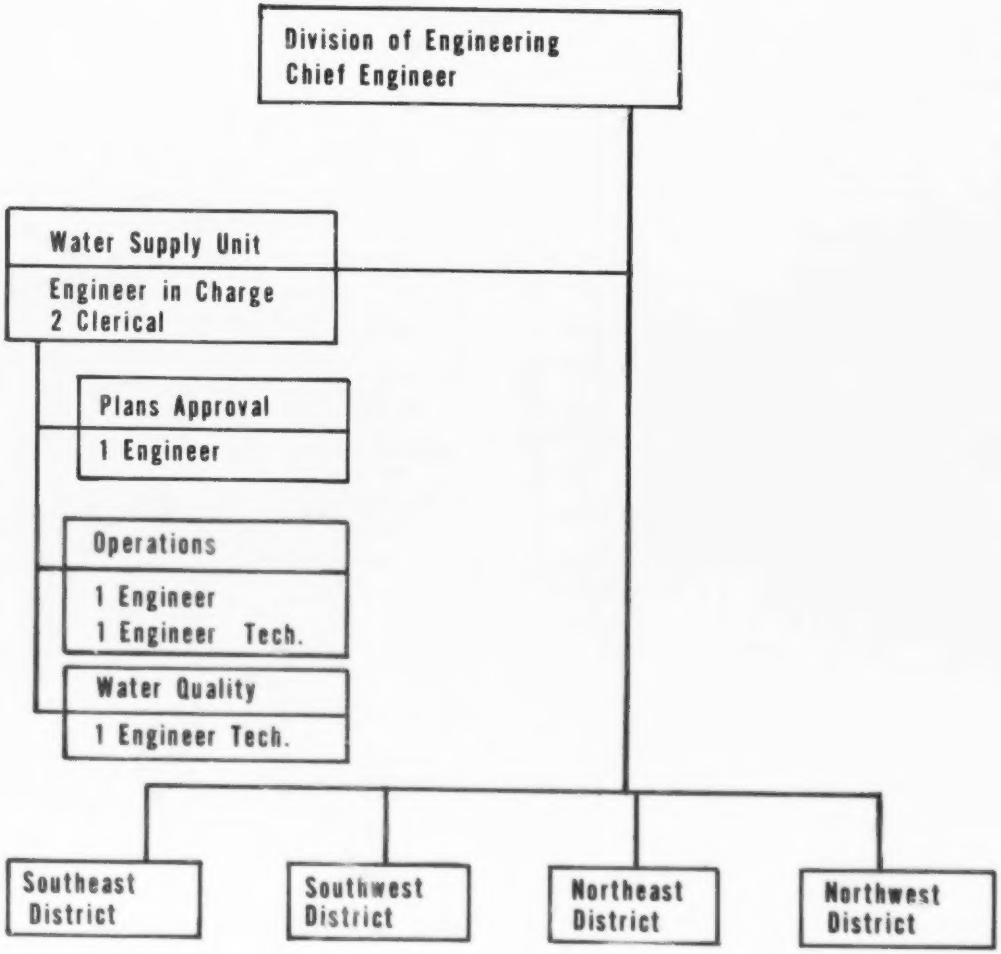
Ohio Department of Health   Division of Engineering Organization Chart


Director of Health
Water Pollution Control Board
Air Pollution Control Board
Radiological Health Advisory Board
Bureau of Environmental Health
Public Health Council
Water and Wastewater Certification Board
Chief Engineer Division of Engineering
Administrative Unit
Sections
Data Processing
Accident Prevention Unit
Air Pollution Unit
Sections
Plans
Air Quality Standards
Surveys & Studies
General Engineering Unit
Sections
Solid Wastes
Public Buildings
Plumbing Unit
Sections
Inspections
Plans
Training & Certification
Water Supply Unit
Sections
Plans Approval
Operations
Water Quality
Sewage & Industrial Wastes Unit
Sections
Plans (Sewage)
Operations (Sewage)
Industrial Wastes
Water Quality Standards
Radiological Health
Northeast District
Northwest District
Southeast District
Southwest District

January 1972

Figure 17

Water Supply Unit Organization


Division of Engineering
Chief Engineer
Water Supply Unit
Engineer in Charge
2 Clerical
Plans Approval
1 Engineer
Operations
1 Engineer
1 Engineer Tech.
Water Quality
1 Engineer Tech.
Southeast District
Southwest District
Northeast District
Northwest District

January 1972

Semi-Public Water Supply Program

The semi-public water supply program is administered by three Divisions of the Department of Health, with much of the inspection work done by boards of health for general and city health districts. In the Division of Engineering, plans review for semi-public water supplies is done by the General Engineering Unit and preconstruction site inspections are done by District Office personnel. The Division of Nursing provides for the inspection of nursing homes and rest homes. Such inspections include review of the water supplies provided. The Division of Sanitation is responsible for surveillance of the operation and maintenance of semi-public water supplies covered by State regulation in cooperation with boards of health for general and city health districts. In addition to the three Divisions involved, the Bureau of Public Health Laboratories provides laboratory support principally for bacterial analyses of samples from the semi-public water supplies. The organizational relationships of these Divisions and Bureau are shown by Figure 18.

Community Water Supply Activities

Water Supply Unit Resources

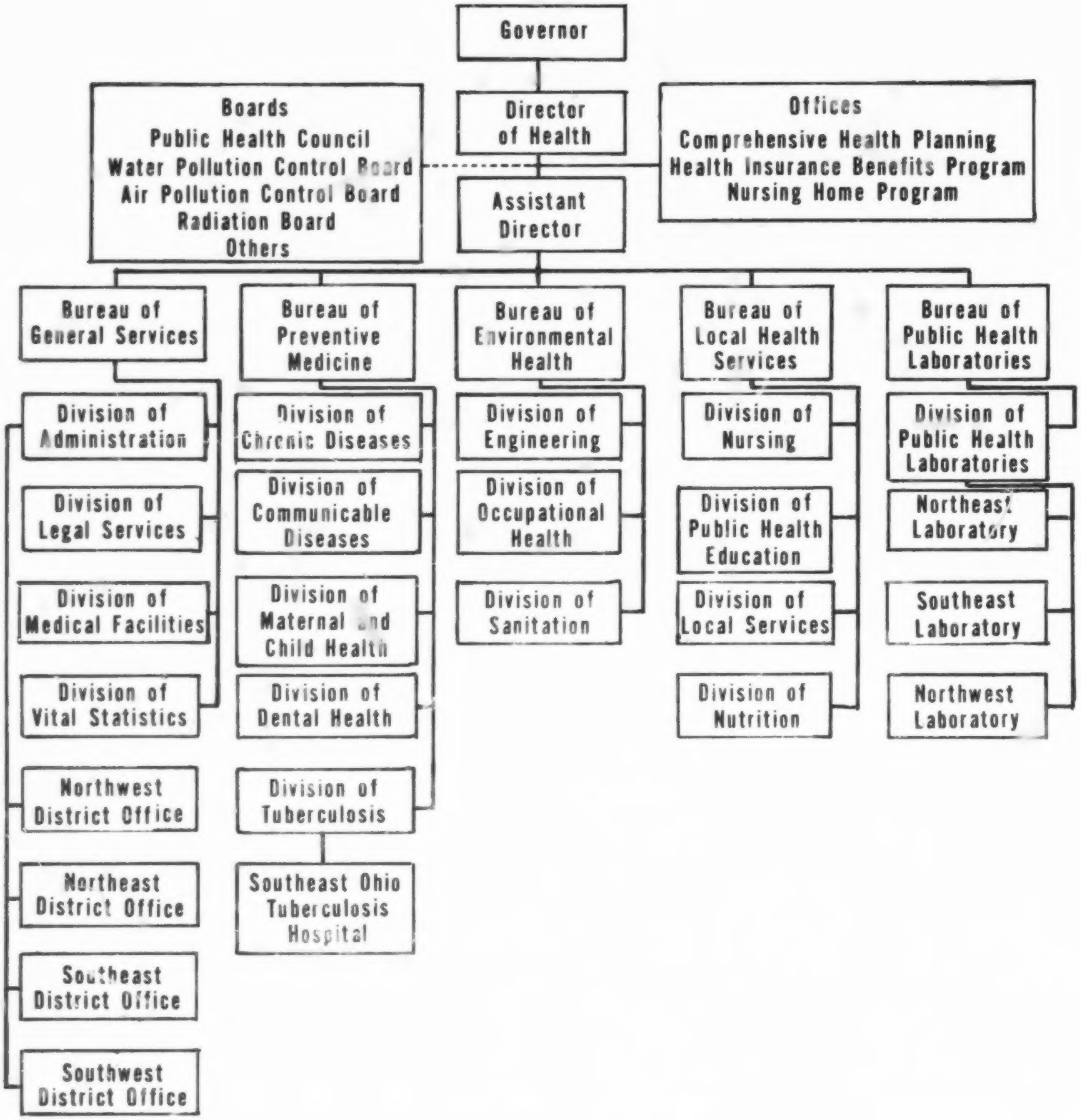
Figure 17 shows the Water Supply Unit has a staff of three engineers, two engineer technicians, and two clerical personnel. Table 7 presents a summary of the qualifications of the professional staff.

Table 7 shows that the staff is well qualified with regard to formal training (four bachelors degrees and two masters degrees) and is particularly strong in experience (average of 17 years per man). The staff's qualifications are reflected by their category ratings.

Figure 18

State of Ohio

Department of Health Organizational Chart


Governor
Director of Health
Boards
Public Health Council
Water Pollution Control Board
Air Pollution Control Board
Radiation Board
Others
Offices
Comprehensive Health Planning
Health Insurance Benefits Program
Nursing Home Program
Assistant Director
Bureau of General Services
Bureau of Preventive Medicine
Bureau of Environmental Health
Bureau of Local Health Services
Bureau of Public Health Laboratories
Division of Administration
Division of Legal Services
Division of Medical Facilities
Division of Vital Statistics
Northwest District Office
Northeast District Office
Southeast District Office
Southwest District Office
Division of Chronic Diseases
Division of Communicable Diseases
Division of Maternal and Child Health
Division of Dental Health
Division of Tuberculosis
Southeast Ohio Tuberculosis Hospital
Division of Engineering
Division of Occupational Health
Division of Sanitation
Division of Nursing
Division of Public Health Education
Division of Local Services
Division of Nutrition
Division of Public Health Laboratories
Northeast Laboratory
Southeast Laboratory
Northwest Laboratory

1968

Table 7

Ohio Department of Health
Water Supply Unit
Professional Staff Qualifications

Category	Bachelors Degree	Masters Degree	Professional Registration	Experience in Water Supply
Public Health Engineer 7	Ch.E.	MPH	Yes	35 years
Public Health Engineer 6	C.E.	MSE	Yes	20 years
Public Health Engineer 6	C.E.	No	Yes	25 years
Engineer Technician 7	No	No	No	6 years 20 years city government 12 years state chemist
Engineer Technician 3	Biological	No	No	2 years

1/1/72

Engineer Technicians are rated from one to seven and Public Health Engineers are rated from one to nine, with step one being the entry level. It is noted that only one staff member has less than 20 years of experience. This lack of personnel with intermediate experience may indicate future problems in maintaining program continuity.

Estimates of expenditures for the community water supply program for 1971 are Water Supply Unit - $85,000 and District Offices $40,000 (salary, benefits, travel). This $125,000 amounts to about $154 expended on community water supply activities for each of the 812 community water supplies. Expenditures for water supply activities are difficult to determine because such activities have no line item in budget planning, allocation, or accounting.

Water Supply Unit Activities

The activities of the Water Supply Unit are determined by the authorities previously enumerated, the rules and regulations established by the Public Health Council, and the policies determined by the Chief Engineer.

The Engineer-in-Charge of the Unit directs operations of the three sections; maintains liaison with other agencies such as HUD, FHA, EDA, the Public Utilities Commission of Ohio, the Ohio Water Development Authority, the Planning Section of the Department of Natural Resources; provides input to water resources planning groups such as the Great Lakes Basin Commission and the State Water Plan; and participates in and directs special studies.

Operations Section

The Operations Section is responsible for monitoring District surveillance activities, maintaining surveillance records on all community water supplies, supervising fluoridation, supervising cross connection control, administering wastewater discharge permits for water treatment plants and conducting special investigations.

District Surveillance

District personnel engaged in community water supply inspection are periodically called into Columbus to review problems and activities, but no systematic check of surveillance is kept. A primary problem is a mutual feeling of lack of support from each other between the Water Supply Unit and the District Offices.

Records

The Operations Section develops forms for the reporting of data and distributes the forms to appropriate individuals. Operator's reports, inspection reports, water quality analyses, and plans approval provide the basic data on most public water supplies. The operator's reports include a monthly report of operation required from all community water supplies (see Appendix A-1), a monthly bacteriological report for those supplies using laboratories other than those of the Department of Health (see Appendix A-3), a monthly operational report for lime soda softening, iron removal or ion exchange plants (see Appendix A-2), and a monthly operational report for purification plants (see Appendix A-2). These reports are received by the District Offices, reviewed, logged in, and referred to the Operations Section. Data is stored on computer tapes as well as files, but no computer programs have been developed for selective retrieval of these data. All data is filed and retrieved by hand. A memorandum providing directions on how to complete the monthly report forms is available (see Appendix A-1). Inspection reports are completed for the record by the District inspection engineers and are followed by letters to responsible officials outlining the results of the inspections. The latest community water supply inventory included 1968-69 data and was published in 1971. The inventory is organized by river basin and by county.

Fluoridation

In 1969 the State legislature passed a mandatory fluoridation law which required all water supplies (47) serving over 20,000 people to fluoridate by January 1, 1971, and required all water supplies (116) serving 5,000 to 20,000 people to fluoridate by January 1, 1972. Communities could reject fluoridation by referendum within six months of the passage of the fluoridation law. Thirty-seven communities held such referenda, with 34 voting rejection (including Milford, population 4,800). It is interesting to note that two supplies having natural fluoridation rejected fluoridation.

As of January 1970, 45 water supplies serving more than 5,000 people were fluoridating, and six were supplying naturally fluoridated water. As of March 1972, 70 such supplies were fluoridating. Fifty-six supplies required by law to fluoridate are not doing so. Included in this number are five of the largest supplies in the State; the Canton, Cincinnati, Columbus, Dayton, and Montgomery County, Great Moraine water systems. These 56 supplies serve over 2,700,000 people. The water supplies required to fluoridate which are not doing so are located in the Districts as follows: eight in the Northwest District, 22 in the Southwest District, eight in the Southeast District and 18 in the Northeast District.

No special effort to obtain fluoridation as required by law has been made by the District Offices. No specific instructions on action which should be taken to encourage fluoridation has been received by the Districts from the central office. Several months prior to the dates of fluoridation required by law the subject water supplies were notified by letter of the need for submission of plans and steps necessary to obtain fluoridation. Shortly after the law's passage, brochures were made available to the public and water supplies concerned through the central and District Offices. This material described very well the status of fluoridation in the State and gave an excellent review of the technical requirements for fluoridation. Such information was meant to assist the water supply operators and supervisors in evaluating the methods and means of fluoridation which would be appropriate for their systems. No strong effort to support fluoridation in the various referenda which were held was made by the Department of Health. No effort to educate the water supply operators on the benefits and advisability of fluoridation was made by the Division of Engineering.

The fluoridation law is weak in that it established no strong penalties for noncompliance, except as provided under Section 6111 of the State Code. There would, however, seem to be little reason for noncompliance by municipalities in view of the fact that the law provides for State reimbursement to municipalities for the capital expense in initiating fluoridation. Certification of installation of fluoride equipment is done by the Operations Section. The primary reason for noncompliance would appear to be a lack of conviction in the minds of local people and officials regarding the benefits of fluoridation. Thus, the failure to fluoridate may, in some cases, be an educative failure on the part of the Department of Health.

Despite the lack of full compliance with the law, the law must be judged a partial success since 25 supplies serving 606,000 people are now fluoridating due to the law. As of March 1972, a total of 78 supplies provided fluoridated water to over 4,711,000 people in Ohio. (Eight supplies serving <5,000 people fluoridate.)

The Division of Engineering learns of a water utility's intent to fluoridate through the receipt of plans for review and approval. Control of the fluoridation operation is obtained by requiring a monthly State laboratory fluoride analysis which is compared to an analysis on the same sample by the water utility, daily analyses run and recorded by the water utility, and daily recording of the fluoride added in ppm by the water utility. The daily analyses and the daily concentrations by calculation should be recorded on the monthly operator's chemical use report form. No place is, however, provided on this form for either statistic (see Appendix A-1).

Cross Connection Control

Cross connection control has long been discussed and neglected. Although District engineers are aware of the subject, little emphasis or action is taken to encourage and sustain cross connection control programs. The Operations Section has prepared a cross connection control regulation which was adopted by the Public Health Council in May of 1972 and became effective in July 1972. This regulation will provide guidance for cross connection control by containment (prevention of backflow from service connections to water supply mains). Following adoption of the regulation, the Operations Section plans to work with the District Offices and the Operators Training Committee of Ohio, Inc., to obtain implementation of cross connection control and train personnel on a State-wide basis.

Wastewater Discharge Permits

Of the 730 water source supplies, 416 practice iron, turbidity, or hardness removal which create waste sludge or brines. Those supplies which discharge to sewerage systems need not obtain discharge permits. All others, however, must provide wastewater treatment and must obtain discharge permits. This program has been recently assigned (although policy was established in 1967) to the District Offices for inspection and compliance.

Permit procedures will be:

1. Operations Section establishes procedures and maintains records for activity.

2. District Offices make inspections and report findings to Operations Section with recommendations for action.

3. Operations Section reviews and recommends action.

4. A work group of the Water Pollution Control Board decides action for compliance. The permits handled in groups with Operations personnel present.

The water supply treatment discharges are classified as follows:

Turbidity removal	93 - 21%
Lime-soda softening	141 - 37%
Ion exchange only	32 - 7%
Iron removal only	85 - 22%
Ion exchange + Iron removal	65 - 13%
Total	416

This permit program constitutes a major activity added to the community water supply program for which no additional staff was initially provided.

Special Studies and Activities

Special activities which are vested in Operations include review of interstate carrier water supply certifications and assistance to the Water and Wastewater Certification Board. Assistance to the Operator Training Committee of Ohio, Inc. is also provided. Special studies on community water supply initiated by the Water Supply Unit, the U.S. EPA or other agencies are coordinated by the Operations Section of the Water Supply Unit.

The interstate carrier program is a U.S. EPA program in which the State cooperates. Water supplies in the program are inspected annually with inspection reports including water quality records forwarded to EPA for interstate carrier classification. EPA accompanies District Office personnel on triannual inspections.

Assistance provided to the Water and Wastewater Operators Certification Board consists of aid in the development and conduct of operator certification examinations. The Operator Training Committee of Ohio is aided by participation in planning meetings and the development of specialized curricula in subjects such as cross connection control.

Plans Review Section

Ohio law requires Department of Health approval of plans for the installation or alteration of any public water supply. The Department of Health has required that plans be submitted on intake, reservoir, transmission main, treatment plant, and distribution main (generally limited to greater than eight inches in diameter) construction or alteration.

From 200 to 300 plans are reviewed each year (see Tables 8 and 9). Complete processing of these plans usually takes from two to four weeks. With only one man year applied to this activity, detailed review for all plans is not possible. Approval of plans is based on the criteria of reasonableness. If the implementation of the plans can be expected to provide a reasonable solution to the problem, the plans are approved. No attempt is made to assure that a "best" plan is approved, since such a plan would vary depending on engineering opinion and funds available

Table 8

Summary Plan Approvals 1971

Date	Plans	Estimated Cost of Projects
January	30	$2,706,200
February	7	2,160,000
March	22	6,115,550
April	8	98,500
May	20	3,495,300
June	12	7,488,500
July	27	4,936,000
August	32	2,389,300
September	32	1,220,770
October	29	4,041,325
November	33	2,850,280
December	26	1,718,703
Totals	278	$39,220,428

Table 9

Number of Plans Approved

Date	Plans	Estimated Cost of Projects
1961	191	$25,422,000
1962	177	26,210,000
1963	194	17,722,000
1964	240	32,189,000
1965	216	27,122,000
1966	227	31,743,800
1967	258	66,065,500
1968	236	37,781,507
1969	257	54,958,750
1970	235	50,787,390
1971	278	39,220,428

for the project. Although satisfactory performance is expected where approved plans are followed, such performance cannot be guaranteed due to lack of manpower to check detail and follow up on plan implementation. No action is taken to check new installations or improvements for conformance to approved plans.

The "Recommended Standards for Water Works - Great Lakes-Upper Mississippi River Board of State Sanitary Engineers" is used as a guide in plans approval with a few revisions. A "Report on Waste Sludge and Filter Washwater Disposal from Water Softening Plants" is used in the review of plans for lime softening waste disposal from water treatment plants.

The Water Supply Unit does not presently have the manpower to influence water supply planning at the local or State level. Although some input on the existing situation with regard to water supply is provided to State planning, river basin planning, and comprehensive health planning, very little feedback on regional or local plans or trends is received. Little effort is being expended to tie plans review and approval to future needs and river basin and comprehensive health planning.

Water Quality Section

The Water Quality Section is responsible for obtaining water quality data on all public water supplies, investigating analysis results exceeding the PHS Drinking Water Standards, and developing programs for the efficient storage and retrieval of water quality data.

A series of reports and procedural memoranda on water quality data needs and collection have established the direction for Department policy on this phase of public water supply surveillance. These reports and procedures have been prepared in close collaboration with the Department of Health, Bureau of Public Health Laboratories which provides physical, radiological, bacterial, and chemical water quality analysis support to the Division of Engineering. As of October 1970, analysis for heavy metals began for public water supplies, due to reports of mercury and other heavy metals in certain source waters.

A paper written by the Section, "Hazardous Substances in Drinking Water" (Appendix B-2), briefly brings out the need for drinking water quality surveillance.

In December of 1970 the Water Supply Unit "Report on the Need for Expanded Laboratory Services in the Chemical Analyses of Drinking Water" (Appendix B-3) spelled out in detail the sampling and analysis programs required for drinking water quality surveillance. Three sampling programs were described; samples taken during inspections, samples submitted by purveyors for routine monitoring and special samples for fluoride monitoring, new source analysis, sand analyses and special studies. The December 1970 report noted that routine analysis was being run for 15 of the PHS 1962 Drinking Water Standards. Of the eight standards not being run routinely; four, odor, cyanide, MBAS, and phenols, were listed as obtainable upon special request. The four remaining, arsenic, barium, carbon chloroform extract, and selenium were apparently not within the laboratory capability for analysis at that time. The report itemized immediate needs, which included routine analysis of arsenic, barium, phenols, selenium, cyanides, and organics (carbon chloroform extract). Also defined as immediate needs were pesticides and mercury analyses. Barium was added to the routine analysis list in July of 1971. Arsenic and selenium are expected to be added by July 1972. The report and its implementation in the past year demonstrate a strong grasp of the chemical analysis needs for community water supply on the part of the Division of Engineering and good responsiveness on the part of the Bureau of Public Health Laboratories in meeting these needs.

Laboratory Support

The Bureau of Public Health Laboratories of the Department of Health provides water quality analysis support to the Division of Engineering. This support includes physical, radiological, bacteriological, and chemical analyses of drinking water samples.

Sanitary Chemistry Laboratory

The Sanitary Chemistry Laboratory was visited on February 14 and 15, 1972, for the purpose of evaluation by U.S. EPA personnel. The evaluation report (Appendix B-7) found that the laboratory space is adequate and personnel are well qualified. The chemical analyses performed by the Division of Laboratories is quite comprehensive and includes many parameters not listed in the PHS Drinking Water Standards. The Industrial Chemistry Laboratory (not a part of the Sanitary Chemistry Laboratory) is responsible for radiochemistry analysis and pesticide analysis (no pesticide analysis on drinking water was done in 1971, however).

The Sanitary Chemistry Laboratory in 1971 routinely determined color, turbidity, chlorides, fluorides, nitrates, sulfates, total dissolved solids, barium, cadmium, chromium, copper, iron, lead, manganese, silver, and zinc as required by the PHS Drinking Water Standards. In addition, calcium, magnesium, sodium, potassium, aluminum, beryllium, hardness, pH, and alkalinity (total phenolphthalein and $CaCO_3$) were routinely determined, even though these are not required by the Standards. Odor, cyanide, carbon chloroform extract, surfactants, arsenic, selenium, phenols, gross beta, radium 226, or strontium 90 were not done. In summary, of 29 determinations routinely run, standards for 16 are specified by the Drinking Water Standards. Ten standards specified by the DWS were seldom done in 1971. Turbidity is the only substance being determined at present by a non-standard method. The analysis of 21 additional parameters, including most of the DWS omitted in 1971, has been requested by the Water Supply Unit.

The Sanitary Chemistry Laboratory has the equipment for mercury analysis and is purchasing equipment for the analysis of arsenic and selenium by atomic absorption. An auto-analyzer which will enable the determination of cyanide and surfactants is also on order. Equipment for the determination of the carbon chloroform extract is not available, but it was recommended by the U.S. EPA survey officer that procurement of this equipment be delayed until the new mini-sampler being developed by the U.S. EPA becomes available. It was recommended a Hach Model 2100 turbidimeter be obtained.

The Industrial Chemistry Laboratory has the equipment to do gross beta, radium 226, strontium 90, and pesticides, but has no present plans for its use in the analysis of potable waters.

According to laboratory records, 2,614 samples were analysed during 1971 (each for about 29 substances) for the Water Supply Unit. No printout of the data by sample location or water supply was available, although data had been keypunched. There were 911 samples analysed for fluorides in 1971. This represents the monthly fluoride analysis check on the 78 fluoridating public water supplies.

The water chemistry staff consists of a chief chemist who devotes about one half of his time to problems concerned with potable water analysis, two assistant chemists with degrees, and one technician. The equipment is available, or will be shortly, so that all of the chemistries specified by the Drinking Water Standards, except carbon chloroform extraction, could be carried out. Additional personnel are needed to carry out the required chemistries necessary to define water quality as specified by the December 1970 Water Supply Unit report. These chemistries include pesticides and should also include radiochemical analysis.

Water Bacteriology Laboratory

The Water Bacteriology Laboratory provides bacterial analysis services to local health departments (private water supply), the Water Supply Unit (community water supply), and, in the summer, the Department of Natural Resources (recreational waters at State Parks).

Work is done in the central (Columbus) laboratory and three branch laboratories. The central staff consists of a Bacteriologist III, a Bacteriologist II, a Bacteriologist I, and supporting personnel for media and glassware preparation. The branch laboratories are staffed by one or two bacteriologists and supporting personnel.

Two bacteriologists from the central laboratory have been certified by the U.S. EPA as laboratory survey officers. These bacteriologists inspect 165 water plant bacteriological laboratories every three years. Reports on water plant bacteriological laboratories serving interstate carrier water supplies are provided to the U.S. EPA.

The average monthly work load for 1971 was 5,150 samples. Thirty percent, or about 1,545 samples per month, were from community water supplies. Under Water Supply Unit policy all ground water supplies serving fewer than 10,000 people may have the necessary distribution samples done by the Water Bacteriology Laboratory. All surface water supplies and ground water supplies serving more than 10,000 people are expected to provide approved laboratory facilities or to contract with an approved laboratory for bacteriological laboratories were approved. Sixty-two water supplies need to provide approved facilities or contract to have bacterial examinations done. Twenty-eight of these are surface supplies serving fewer than 1,000 people.

The policy for laboratory service does not define service to be provided to master-metered water supplies. Presumably such supplies should be treated as ground water supplies. Of 92 master-metered water supplies, 72 serve populations of fewer than 10,000, and 70 of the 72 do not have laboratory facilities. Of the 20 serving more than 10,000 people, only two provide approved laboratory facilities.

Until the water supplies not having laboratory facilities or contracting services obtain such facilities or services, the State laboratory should continue to provide the service.

The total monthly work load, if State requirements are met, would be:

Ground Water Serving 10,000 (514 supplies)	
Distribution Samples	1370
Source Samples (100 subject to contamination, 414 not subject)	614
Plant Samples	614
Supplies not having lab facilities (62 supplies)	
Distribution Samples	325
Source Samples (4/month per supply)	248
Plant Samples (4/month per supply)	248
Secondary Supplies (92)	
Distribution Samples (estimated)	250

The total monthly work load is about 3,600 samples per month, over double that presently done. Attainment of this work load, of course, depends upon motivation of the operators to collect and mail the required samples. A portion of this work load can be expected to be dropped as more surface water supplies and ground water and secondary supplies serving over 10,000 people contract for, or provide, laboratory services. The laboratory work load, with maximum expected compliance with State requirements, is about 3,000 samples per month, almost double the present work load.

Laboratory certification or approval needs will exceed 200 water supply laboratories if State requirements are met for those supplies serving more than 1,000 people.

District Operations

The District Offices of the Division of Engineering are responsible for the inspection and surveillance of public water supplies in Ohio. Semi-public water supply surveillance and inspection is primarily done by the Division of Sanitation District Offices, with assistance from the Division of Engineering District personnel and local health departments.

During the weeks of January 10 and January 17, 1972, the District Offices were visited by U.S. EPA personnel for the purpose of obtaining information on the status of water supply surveillance and on surveillance operations and procedures. These visits consisted of two days spent in discussion and review of records and one day in the field observing typical inspection procedures. The following comments on District Office operation are limited to the Division of Engineering.

The District Office staff is directly under the supervision of the Principal District Engineer, who reports directly to the Chief Engineer, Division of Engineering, in the central office. The Water Supply Unit staff reports directly to the Chief Engineer. Official liaison between the Water Supply Unit and the District staffs is indirect, through the Chief Engineer.

Northwest District - Bowling Green

There were 272 community water supplies in this District as of January 1972. The Northwest District has 13 engineers assigned to the Division of Engineering's operational responsibilities. The organization chart in Figure 19 shows the major elements to which these personnel are assigned. The Principal District Engineer, the engineer assigned to large municipal treatment plants, and the five engineers assigned to general engineering all work part time on community water supply. The engineer assigned large municipal treatment plants is responsible for activities dealing with all water and sewage plants in the District which treat greater than one million gallons per day. He spent six percent of his time, or 13 man days, on community water supply in 1971. The engineers assigned to general engineering are responsible for from three to seven counties in the District. For these areas they must provide surveillance over community water supply and sewage treatment systems (under one million gallons per day), develop information for enforcement hearings, review plans for semi-public water supply and sewage treatment systems, inspect semi-public sewage treatment systems, review swimming pool and solid waste disposal plans, assist stream water quality surveillance, and provide trailer park plans review and site inspections. In 1971 the time spent on community water supply by these men varied from three to ten percent, or an average of 11 man days each. The Principal District Engineer provides program direction and assists the engineers in general engineering. In 1971 the Principal District Engineer spent 12 percent of his time, or 26 man days, on community water supply. Table 10 shows the time spent by month on community water

Table 10

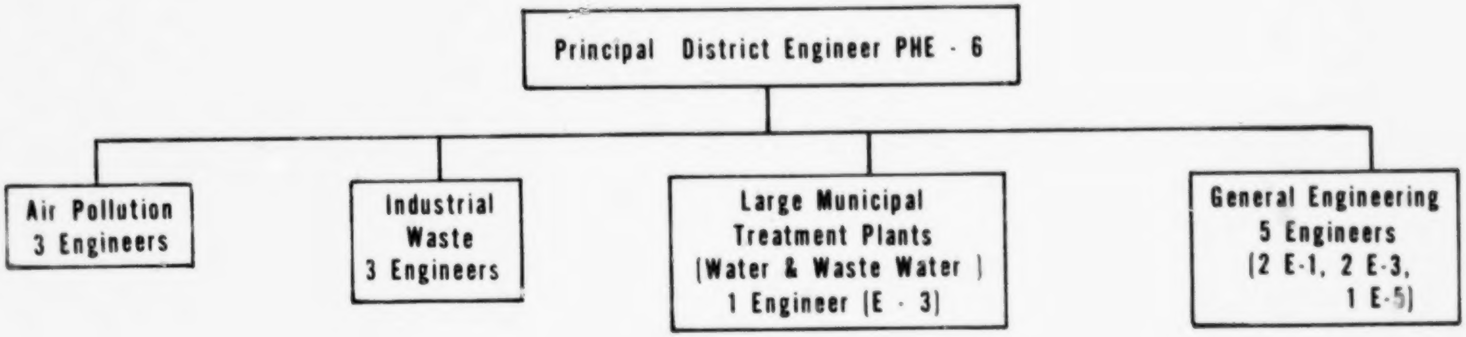
Northwest District Office
Percent of Time Spent on Water Supply
1971

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Principal Engineer	6	4	5	8	4	6	6	14	30	9	10	41
1 MGD or more Supplies	5	5	0	0	3	3	1	3	3	2	7	31
General Engineering Under 1 MGD	5	5	4	7	4	3	10	4	9	3	6	12

Assume 222 working days per year per man
Over-all: Principal Engineer 12%, Supplies of 1 MGD or more 6%, General Engineering 5%.

Figure 19

Northwest District Organization Chart


Principal District Engineer PHE - 6
Air Pollution
3 Engineers
Industrial
Waste
3 Engineers
Large Municipal
Treatment Plants
(Water & Waste Water)
1 Engineer (E - 3)
General Engineering
5 Engineers
(2 E-1, 2 E-3,
1 E-5)

January 1972

supply. In 1971 total time spent on community water supply surveillance was less than 0.5 man years.

Southwest District - Dayton

There were 182 community water supplies in this District as of January 1972. The Southwest District has ten engineers assigned to the Division of Engineering's operational responsibilities. The organization chart in Figure 20 shows the major elements to which these personnel are assigned.

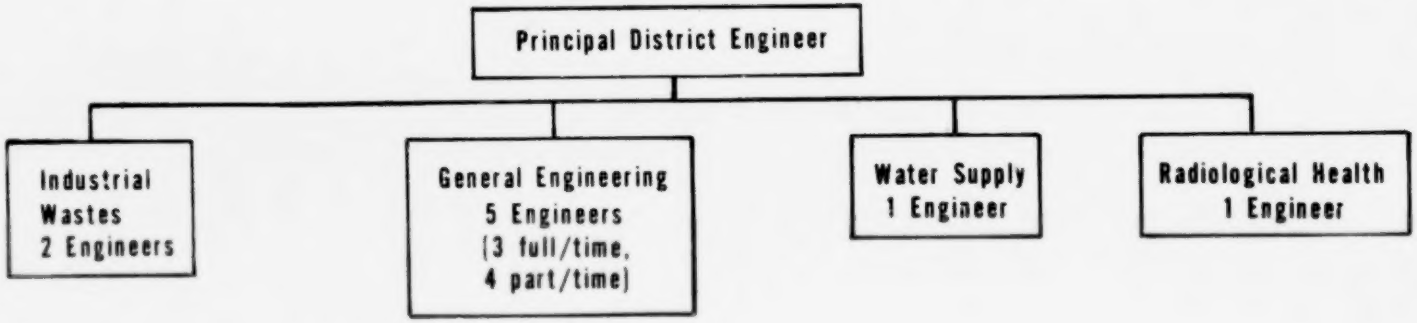
The engineers in general engineering do semi-public plans review including water supply and sewerage plans, sewage treatment plant surveillance, solid waste plan review, inspection of semi-public sewage treatment plants treating over 25,000 gallons per day, trailer park plans review and site inspection, and assist with stream surveillance. A limited amount of community water supply plans review is done. One engineer is assigned to community water supply work and also does swimming pool plan review. Community water supply work done in 1971 included Principal Engineer - 0.1 man year, General Engineering - 0.1 man year, and Water Supply - 0.7 man year. Water supplies having distribution systems and treatment plants which serve State parks are also inspected by the water supply engineer. In 1971 total time expended on community water supply surveillance was 0.9 man year.

Northeast District - Cuyahoga Falls

The Northeast District of the Ohio Department of Health had 253 community water supplies as of January 1972, of which 148 are municipal supplies. The total number of man days spent on water supplies in 1971

Figure 20

Southwest District Organization Chart


Principal District Engineer
Industrial Wastes 2 Engineers
General Engineering 5 Engineers (3 full/time, 4 part/time)
Water Supply 1 Engineer
Radiological Health 1 Engineer

January 1972

was about 125, or about 0.5 man year. This was divided between a consultant (589 man hours) and regular staff (415 man hours divided among six men). The average total man hours for a municipal inspection in 1971 was 7.85 hours, including the visit, reports, correspondence, and follow-up visits.

In 1972 the projected work load will be 600 hours assigned to the consultant and 2800 hours assigned to the staff, based on 1.5 full time personnel assigned only to community water supply.

Southeast District - Nelsonville

There were 216 community water supplies in the Southeast District as of January 1972. During 1971, 236 visits were made. This represents at least one visit per water supply. Field visits last a minimum of one hour for the smallest supplies to a maximum of one day for the larger supplies. The average time spent at any one supply was reported to be two hours.

In visiting water supplies, writing reports, and reviewing bacteriological and chemical data, approximately one man year (2080 man hours) was expended. This represents one engineer technician assigned 90 percent of the time to community water supply and ten percent of the Principal District Engineer's time spent to support and direct the community water supply program. In 1972 the engineer technician will be assigned full time to community water supply work.

Procedures and Practices

Inspections

Pre-inspection work normally consists of reviewing information available in the District files on the water supply to be inspected.

Such information includes the monthly report record, the bacteriological report record, past inspection reports, chemical analyses data, and any other correspondence on the supply.

U.S. EPA personnel accompanied four State inspectors on ten inspections to observe inspection practices. The operators are not normally contacted prior to the inspection visit. The thoroughness of inspection from District to District and inspector to inspector varied considerably. In two Districts no written procedures are provided. Two Districts provided the engineers with different inspection procedures, The inspector neither used the procedure nor was familiar with the procedure. During each inspection the inspector discussed the operator's problems with him, advice was often offered but not assistance, the facility was toured with visits to at least one source and the treatment plant, and chemical samples were taken. Some inspectors completed the inspection report form in the presence of the operator and took a bacterial sample and chlorine residual analysis on the distribution system. Others did neither.

Time spent on individual inspections ranged from one to four hours, with an average of two hours in three Districts, and ranged from two to eight hours, with an average of four hours in one District. Office time per inspection averages about three hours.

Although comprehensive detailed surveys every five years of each supply are requested by the Water Supply Unit, none are done by the District Offices.

Inspection Training

Training of new personnel in inspection procedures and practices is quite limited. Training normally consists of having the new man accompany an experienced man for two or three days of inspections (four to ten water supplies inspected). In two Districts written procedures (both different) are given to each new engineer on how to conduct an inspection. The new man is then allowed to do small supplies and gradually does larger ones as his experience increases. The written procedures, although good, are not emphasized and engineers with several years' experience are not familiar with the procedures and do not use them. Some individuals have taken courses in Cincinnati related to water supply, but not specific to water supply evaluation. Orientation courses or seminars given in Columbus are also not specific to water supply evaluation.

Water Supply Surveillance Records

Each District maintains monthly operational report records, bacterial test result records, and a correspondence file on each water supply. Record keeping methods varied from District to District. The methods are summarized below.

Before the fifteenth of each month, the operator is required to forward the previous month's Monthly Report of Operation to the appropriate District Office. If the treatment plant is classified as a purification or water softening plant, the operator must attach appropriate Chemical Use Reports. If bacteriological analyses are done by laboratories other than those operated by the State, a

Report on the Bacteriological Examiniation of Water for the previous month must also be attached. These records are given a cursory review by the responsible District engineer, are recorded as having been reviewed, and are forwarded to the Water Supply Unit. No monthly summaries are kept. One of the Districts did not record the receipt of Chemical Use or Bacteriological Examination Reports. One District used the symbols M, C, B to designate the receipt of monthly, chemical, or bacteriological reports. One District recorded the date of receipt of the reports. At least one year's monthly operational and chemical use reports should be given a detailed review with a "key" record established for each supply. After the "key" record is established, discrepancies or operational changes should be easily detected by a quick comparison of the "key" record to the monthly report being reviewed. At the end of each year the Water Supply Unit should provide to the District Offices an annual summary of the monthly operational and chemical use reports on each supply submitting such reports. A copy of this summary should be provided to the water supply operator by the District Office.

Bacterial records are maintained primarily for those samples collected by the water system operator and analysed by the State laboratories. Incomplete monthly summaries of sample results from other laboratories are maintained by two Districts. The other two Districts keep no records of sample results from other laboratories. In a number of cases a complete year's record of bacterial analyses could not be found because records had been destroyed after the last inspection was made. At least one year's bacterial record should be maintained on every supply. Sufficient data from the monthly Report on the Bacteriological Examination of Water and the State laboratory results should be recorded to determine compliance or non-compliance with the Drinking Water Standards. Review of the records indicated that many of the samples counted as total distribution samples are taken at the treatment plant or well. Extra samples following bad samples were not designated as repeat samples on the bacterial records. Repeat sample procedures for those supplies not using State laboratories for bacterial sample analysis are not checked by the Districts. Sample procedures and sampling sites are not checked by the Districts unless repeated bad samples are reported by the State laboratory. Bacterial data reported by the State laboratories to the Districts are handled by notifying water supply operators of bad samples by telephone and requesting repeat samples. If repeat samples are bad, the District engineer initiates an investigation to determine the cause of the bad samples and assure elimination of any hazardous conditions. This is usually done by recommending increased chlorination. The recording of chlorine residuals at bacterial sampling points is recommended but is practiced by few supplies. No record of this practice is maintained by the District Offices.

Master-Metered Water Supplies

Master-metered supplies are those distribution systems which purchase water wholesale from another community water supply. Department of Health policy requires that these supplies submit monthly reports and be inspected. Records of distribution system chlorine residuals for such supplies are strongly recommended by the Department of Health. These policies are largely ignored by the District Offices. Few master-metered supplies submit monthly reports and few are visited by District Office personnel in three of the four Districts.

Plans Review

Some Districts take part in community water supply plans review, while others consider such plans review to be entirely a Water Supply Unit reponsibility. Copies of the summary of plan specifications and the Water Supply Unit action on plans approval are provided to the District Offices for inclusion in the water supply's correspondence file. No specific checks on the progress of approved plan implementation by the water supply is made by the District Offices. Notes of changes in facilities are made, however, in the annual inspection reports.

Certification of Operators

Prior to each inspection, the District engineer determines whether the operator is certified. If he is not, the owner of the supply is urged by letter to send the operator to operator training school or to obtain a certified operator or a technical supervisor.

The District engineers do not carry pertinent, up-to-date information on operator training courses for distribution to the operators. The operator is, however, urged to obtain certification and is provided with general information on the Operator Training Committee of Ohio, Inc. training courses.

Cross Connection Control

Very little is done during District inspections with regard to cross connection control. The subject is sometimes discussed with treatment plant operators, but plumbing and building inspectors are seldom contacted. District engineers need orientation on the subject of cross connection control program needs and implementation methods.

Chemical Results

Chemical sample analyses from the State laboratory are not received, in most cases, until four to six weeks after the inspection (samples are collected during the inspections). These results are included in the water supply inspection report with attention called to any constituents exceeding the PHS Drinking Water Standards. The inspection report is, therefore, seldom timely and does not demonstrate a concerned reaction to the inspection's findings. One District sent inspection reports shortly after the inspections and followed up when the chemical analyses were received from the laboratory.

Water Supply Inventory

Water supply inventories are provided from Water Supply Unit file data and are not checked during inspections by the District engineers. District engineers were not familiar with the inventory completed within the last year and did not use it or refer to it. The inventory cannot, therefore, be kept current by the Water Supply Unit.

Fluoridation

The Districts have spent little effort on obtaining compliance with the mandatory fluoridation law and are not familiar with the status of water supply fluoridation in their jursidiction. Lacking direction from the Water Supply Unit or the Chief Engineer's Office, it has been assumed that no specific effort should be taken and that compliance efforts will come from the Water Supply Unit.

Division of Sanitation

Responsibilities for semi-public water supply surveillance within the Division of Sanitation are administered through the organizational structure shown by Figure 21. Direct supervision of operation and maintenance of semi-public water supplies is administered by the boards of health for general and city health districts. Exceptions are migrant labor camps, State parks and recreation areas, and highway rest areas. Figure 22 summarizes the status of regulations for the various areas included in Division of Sanitation activities. Except for the case of public buildings, the State regulations refer to all aspects of good sanitation.

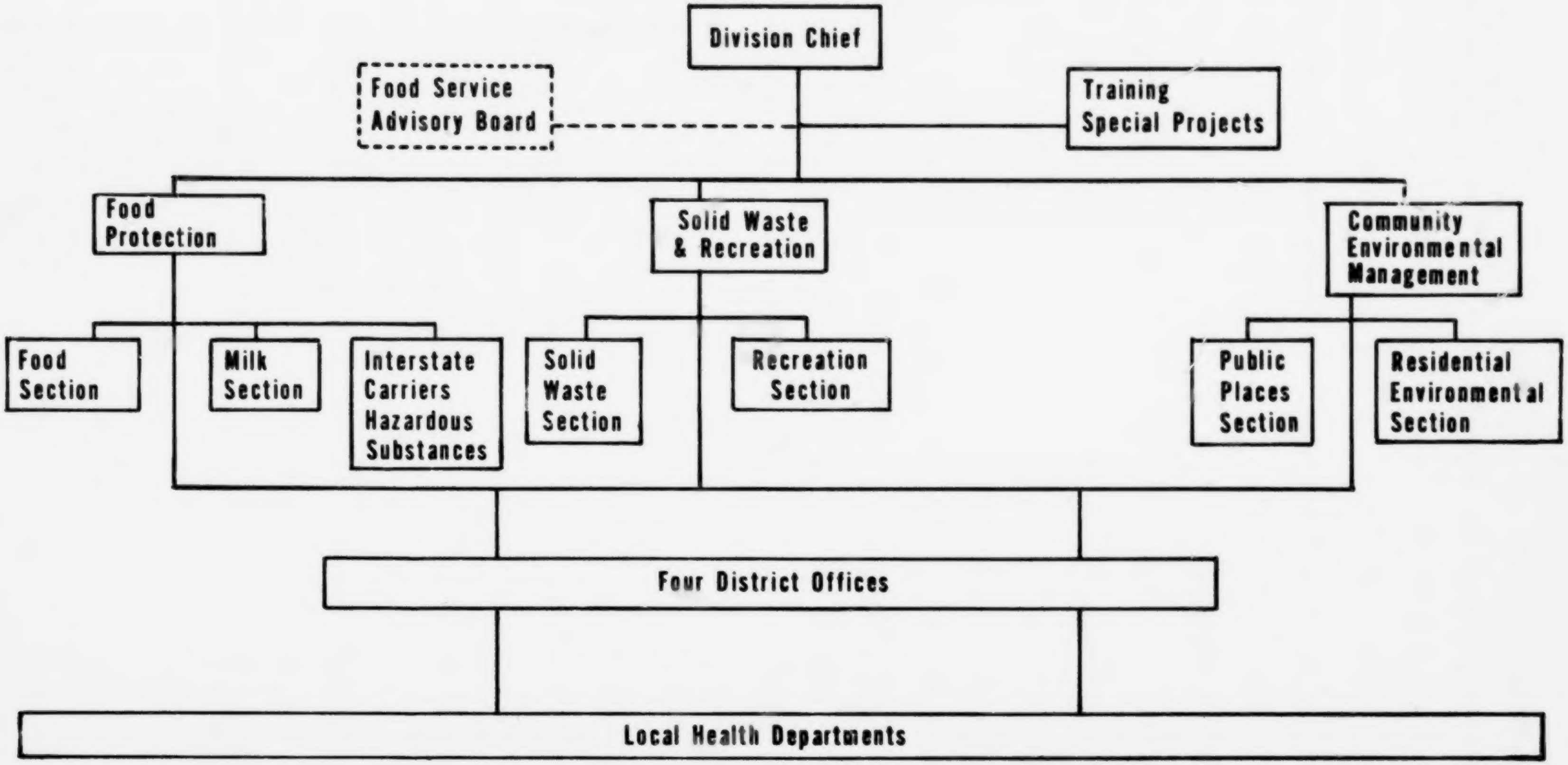
As interpreted by the Water Supply Section, U.S. EPA, semi-public water supply does not include those waters used for food processing or milk processing. Included in the U.S. EPA interpretation are restaurant, travel trailer port, State park and recreation area, camp, resort area, highway rest area, trailer park, school, migrant labor camp, temporary mass gathering, and institutional independent water supplies. Semi-public water supplies not specifically included in Division of Sanitation activities are those serving motels, service stations, industries, and non-State hospitals. Where such public places have food service facilities, the water supplies would be inspected under the food service program.

There are about 630 migrant labor camps in Ohio. Most are located in the Northwest District and have semi-public water supplies. The Division of Sanitation conducts sanitation inspections of these camps on an annual basis. Reinspections are made where appreciable improvements

Figure 21

Ohio Department of Health

Division of Sanitation Organization Chart


Division Chief
Food Service Advisory Board
Training Special Projects
Food Protection
Solid Waste & Recreation
Community Environmental Management
Food Section
Milk Section
Interstate Carriers Hazardous Substances
Solid Waste Section
Recreation Section
Public Places Section
Residential Environmental Section
Four District Offices
Local Health Departments

1972

Figure 22

Ohio Department of Health
Division of Sanitation Program Delineation

FOOD PROTECTION

	Food Service	Food Vending Machines	Food Establishments	Fluid Milk	Other Milk Products	Hazardous Substances	Interstate Common Carrier
O.D.H.	X	X	Y	X	Y	X	X
Local Health	X	X	Z	Z	Z	Z	Z

	SOLID WASTE		RECREATION							
	Disposal	Collection	Travel Trailer Ports	State Parks and Recreation Areas	Swimming Pools	Bathing Areas	Camps	Resort Areas	Spec. San. Dist.	Highway Rest Areas
O.D.H.	X	Y	Y	ZZ	Y	Y	Y	Y	X	ZZ
Local Health	X	Z	Z	Z	X	X	X	X	Z	-

COMMUNITY ENVIRONMENTAL MANAGEMENT

	Public Places					Residential				
	Trailer Parks	Schools	Migrant Labor Camps	Temporary Mass Gatherings	Institutional Environ.	Disaster Sanitation	Pesticides	Insect & Rodent Control	Premise Sanitation	Housing
O.D.H.	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Local Health	X	X	X	Z	Z	Z	Z	Z	Z	Z

X = Mandatory by State law/regulation
Y = Consultative service
Z = Voluntary or local regulation
ZZ = Mutual agreement with another State agency

have been required. Inspection procedures require checks of the water supply source location and development and one bacterial sample annually. Records of bacterial results and descriptions of the water supplies are kept on standard forms maintained in local board of health files.

There are over 5100 public and private high and grade schools in Ohio. A small proportion of these schools have semi-public water supplies. Local boards of health are required by State law to make semiannual sanitation inspections of all such schools. Water supply guidelines as defined by "Sanitation in the School Environment" and "Guideline for the Evaluation of School Programs" are satisfactory where administered by well trained, conscientious personnel. The guidelines do not define satisfactory water quality. Only annual bacterial samples are required. The Division of Sanitation has a policy of evaluating local school sanitation programs triannually. In the past three years fewer than 70 of the 161 programs have been evaluated. The evaluations are quite detailed and include State inspection of a large number of the schools under the local board's jurisdiction.

There are about 1,400 trailer parks in Ohio. A large proportion of these trailer parks have semi-public water supplies. Local boards of health are required by State law to make inspections of trailer parks. Water supply guidelines as defined by "Trailer Park Program Sanitation Review Guideline" are satisfactory where administered by well trained, conscientious personnel. The guidelines do not define satisfactory water quality. Only annual bacterial samples are required. The Division of Sanitation has a policy of evaluating local trailer park sanitation programs triannually. In the past three years, less than one-half of the 161 programs have been evaluated. The evaluations are quite detailed and include State inspections of a large number of the trailer parks under the local boards' jurisdiction.

There are over 514 resident and family camps and 41 State parks in Ohio. In addition, there are over 100 recreation areas administered by Federal agencies, conservancy districts, the State Division of Wildlife and the Ohio Historical Society. Over 300 highway rest areas are maintained by the State Highway Department. A large proportion of these facilities have semi-public water supplies. State law requires inspection of resident and family camps and resorts by local boards of health. State parks and conservancy district recreation areas are inspected by the Division of Sanitation annually. Federal recreation areas are not inspected by State or local agencies. The State Highway Department is provided with a special training program conducted by the Division of Sanitation for the rest area operators. Water supply guidelines as defined by "Camp Program Sanitation Review Guideline," "Camp Regulations Guide for Resident Camps" and "Camp Regulations Guide for Family Camps" are satisfactory where administered by well trained, conscientious personnel. Camp guidelines require at least annual inspections and two bacterial samples per year. A more frequent sampling schedule is required of State parks and conservancy districts. The guidelines do not define satisfactory quality. The Division of Sanitation has a policy of evaluating the local camp sanitation programs triannually. Many of these programs have not been evaluated in the past three years.

The food service sanitation program includes inspection of the small proportion of the State's restaurants served by semi-public water supplies. Guidelines as defined by "Food Service Operation - Law, Regulations, and Interpretive Guide" for the evaluation of water supply are inadequate. Location, construction, and quality standards of the Ohio Department of Health are referenced but no such standards have been established. Under Plan Review, Section 3701.18 of the State law, however, plans for water supplies serving food service operations must be approved by the Division of Engineering. The guides do not define satisfactory water quality or sampling requirements. Division of Sanitation policy, however, requires at least annual bacterial sampling with more frequent sampling where problems may be encountered. Under the State law local boards of health must conduct annual inspections of food service operations. These local inspection programs must be approved by the Division of Sanitation. The law requires the Division of Sanitation (actually the Director of Health) to survey periodically all local board of health food service sanitation programs. Such surveys are conducted annually with a statistically significant sample of the establishments under local board of health jurisdiction subjected to State inspection. Approval of the local inspection programs in partially dependent upon adherence to the Division's policy on bacterial sampling and adherence to the Plan Review law.

The Division of Sanitation places emphasis on training for local board of health personnel. This training includes special seminars and workshops of up to a week's duration, a 16 week "Basic Sanitarian

Training" program, and a four week "Principles of Environmental Health" course offered three times a year. The training provided applicable to semi-public water supply inspection was not evaluated for this study.

Recent increases in funding and staffing for the Division of Sanitation may provide the program activity necessary to improve the frequency of local camp, trailer park, and school sanitation program evaluations. Methods for evaluation of State and local programs are being considered utilizing statistical techniques which are well conceived and innovative.

In summary, data to determine the adequacy of semi-public water supply activities administered by the Division of Sanitation is not available in the Division's records. Certain types of facilities using semi-public water supplies are not included under State regulations or the Division's activities. The Division's program of evaluation of local camp, school and trailer park sanitation programs appears to be well conceived but poorly implemented in the recent past. Recent increases in program staff may change this record. Training efforts are emphasized by the Division. Water supply evaluation guidelines are satisfactory with the exception of those specified for food service inspections. Water quality sampling requirements, except those proposed for State parks, are very weak and the definition of satisfactory quality is wholly inadequate.

Department of Natural Resources Water Supply Activities

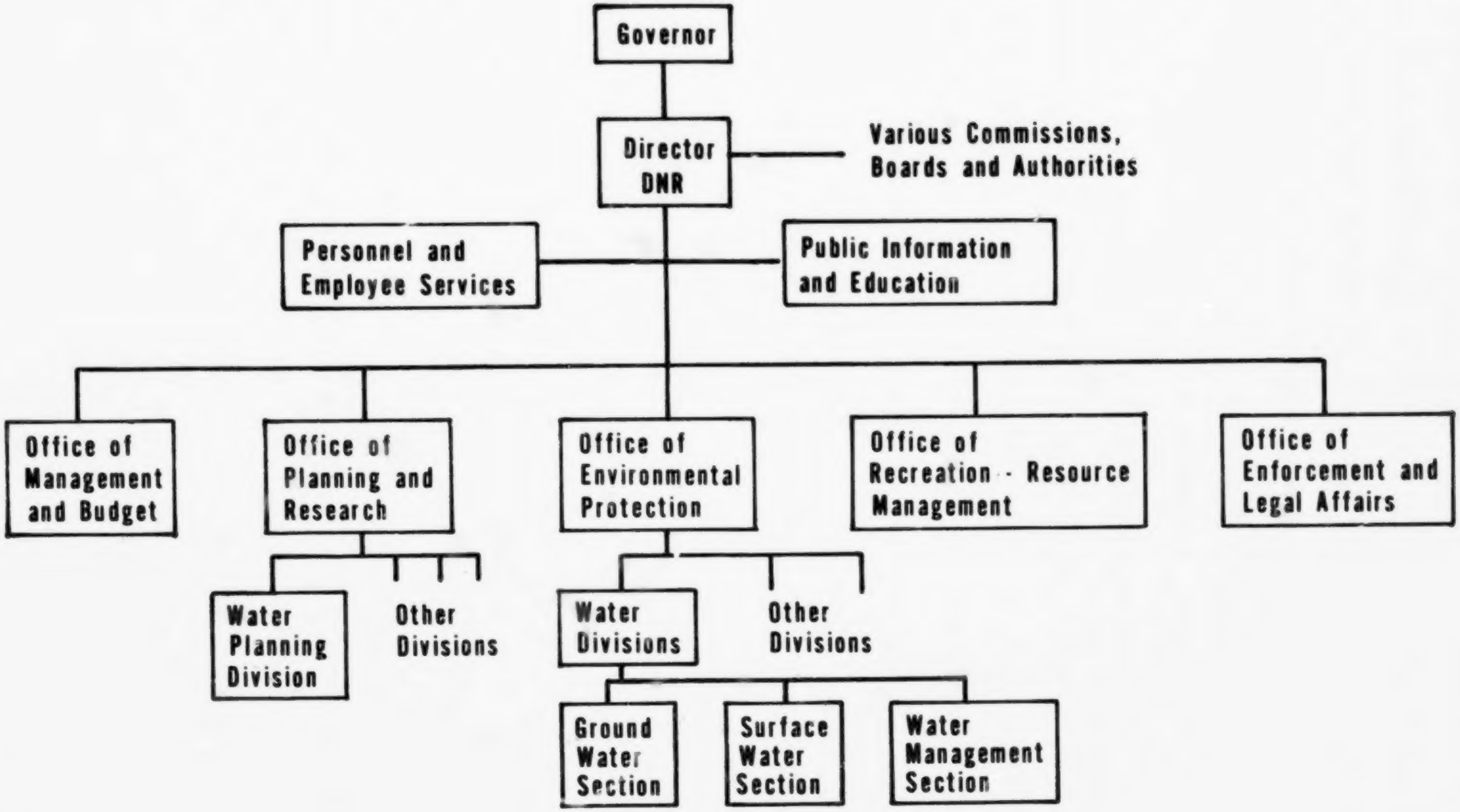
The Ohio Department of Natural Resources (DNR) is responsible for the conservation, development, and use of Ohio's natural resources. With regard to water resources and drinking water use, DNR develops data on the quantity and quality of ground and surface waters, develops plans for the protection and future use of these waters, and aids and guides other agencies in the implementation of these plans.

Figure 23 shows the organization of DNR and those offices which are concerned with water resources and drinking water use. The Ground Water Section and the Surface Water Section are responsible for developing adequate data describing the State's water resources. The Water Planning Division is responsible for the development of plans describing the best alternatives for future use and conservation of water resources. The Water Management Section is responsible for the implementation of the future use plans.

The Ground Water Section maintains an inventory of over 350,000 well logs with over 15,000 new wells produced each year. These logs in most cases provide information on the types and depths of material under the ground surface and can be used to evaluate ground water conditions for most areas of the State. Data is lacking, however, on ground water quality and production capacity. To obtain such data on the primary aquifers of the State, the Section either contracts for ground water evaluations or conducts its own test well and production well program. About 200 water quality samples are taken each year by the Section. Analysis is provided on a cost basis by the U.S. Geo-

Figure 23

Organization of the Ohio Department of Natural Resources


Governor
Director DNR
Various Commissions, Boards and Authorities
Personnel and Employee Services
Public Information and Education
Office of Management and Budget
Office of Planning and Research
Office of Environmental Protection
Office of Recreation - Resource Management
Office of Enforcement and Legal Affairs
Water Planning Division
Other Divisions
Water Divisions
Other Divisions
Ground Water Section
Surface Water Section
Water Management Section

1972

logical Survey. Some sample analysis is provided by the Ohio Department of Health, Division of Laboratories. Problems include lack of complete reporting on newly drilled wells (it is estimated well logs are received on 65 percent of the wells drilled), no uniform State-wide regulations to control drilling practices, no uniform State-wide enforcement of good well drilling practices, lack of complete water quality data, and lack of well production capacity data. This Section is presently staffed by 14 professionals (including eight geologists) and one secretary. Complete State-wide enforcement of drilling regulations would require and estimated increase of 16-18 personnel (about $250,000).

The Surface Water Section develops data on surface water hydrology and quality in cooperation with the Ohio Department of Health and the U.S. Geological Survey. The Section is also responsible for the location, evaluation, and inventory of those locations having good potential for water storage.

The Water Planning Division utilizes data from the Ground Water Section and the Surface Water Section to define raw water availability. Other data is used to obtain estimates of demands for present and future use. From these data raw water needs are defined and solutions to meet these needs are derived and evaluated. The best solutions are incorporated into regional plans (the State is divided into five regions) for implementation. The development of regional plans is contracted to private consultants. A staff of five personnel is responsible for monitoring these contracts and obtaining public support for the solutions incorporated in the regional plan. Contact with the public is established prior to plan development so that public input to the various solutions derived is obtained.

The Water Planning Division also provides State input to interstate agency planning (such as the Great Lakes Basin Framework Study) and Federal water resources development projects (Soil Conservation Service, Corps of Engineers, Farmers Home Administration and Housing and Urban Development sponsored or aided projects).

The Water Management Section aids local agencies in developing projects to implement the best solutions defined by Regional Plans and to meet pressing needs in water management. In the area of drinking water supply sources, the Water Management Section is responsible for the management of State owned reservoirs and is the State's contracting agent for Corps of Engineers water resources development. Local agencies are directly assisted in finding solutions to pressing water supply needs. At the present time, assistance is being provided to communities using untreated surface waters to develop complete treatment facilities.

Appendix A

Operations Records

1. Monthly Report of Operation 119

2. Monthly Chemical Use Reports 126

3. Monthly Bacteriological Examination Reports 128

4. Water Supply Works Data Sheet 131

MONTHLY REPORT OF OPERATION
TO THE OHIO DEPARTMENT OF HEALTH

Appendix A
1

NAME OF WATER SUPPLY WORKS ______

Mailing Address

During this month has the source of supply, pumping treatment, storage and distribution facilities been adequate to meet the demand without curtailment of water use or abnormally low system pressure. (If no, explain under comments) ______ (Yes or No)

During this month have there been justifiable complaints on the physical, chemical or biological quality of water in the distribution system (If yes, explain under comments) ______ (Yes or No)

Are wells, water mains, storage facilities and other equipment disinfected after each installment, repair or other modification which may have introduced contamination. (If no, explain under comments) ______ (Yes or No)

Source of Supply ______

Changes in source of supply during the month ______

Type of Treatment	Chemicals Used

Changes in treatment during the month ______

Bacteriological Laboratory ______ (Name)

Approval Number ______

Average Coliform Density of Distribution System Samples for the Month ______ (No. per 100 ml)

If unsafe samples are reported, have repeat samples been collected from the same location until at least two consecutive samples show the water to be of satisfactory quality. ______ (Yes or No)

Comments:

1-5 Identification Code	0
6-9 Report of Operations for the Month	MONTH 19 YEAR
10-16 Population Served	, ,
17-22 Total Number of Water Services	,
23-29 Total Output for Month (MG)	, .
30-35 Average Daily Output (MGD)	.
36-41 Maximum Daily Output (MGD)	.
42-47 Estimated Works Capacity (MGD)	.
48-50 Percent of Water from Surface Sources	
51-53 Percent of Water from Ground Sources	
54-56 Percent of Water from Other Water Works	
57-59 Average Chlorine Dosage (mg/L) Pre	.
60-61 Average Chlorine Dosage (mg/L) Intermediate	.
62-63 Average Chlorine Dosage (mg/L) Post	.
64-65 Minimum Residual Chlorine at Entrance to Distribution System Free	.
66-67 Frequency of Tests ______ Total	.
68-69 Minimum Residual Chlorine at Extremities of Distribution System Free	.
70-71 Frequency of Tests ______ Total	.
72-74 Number of Distribution System Samples Collected During Month for Bacterial Test	
75-76 No. of Samples Reported Unsafe	
Percent of Samples Unsafe	.

Persons in Responsible Charge

	Name	Certificate No.
Source		
Treatment		
Pumping		
Distribution		

Signed ______

Title ______

4955.10 12/65 (10M 1/68)

Appendix A
1

JAMES A. RHODES, Governor

EMMETT W. ARNOLD, M.D.
Director of Health

450 East Town Street
P.O. Box 118
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State of Ohio
Department of Health

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To: Personnel Responsible for Submitting Monthly Reports of Operation of Public Water Supplies in the State of Ohio

From: Division of Engineering, Water Supply Unit

Subject: Monthly Reports on Form No. 4955.10

Because of the value of and many uses for the data in this Monthly Report of Operation, the form should be filled out and sent to the appropriate District Office of the Department within two weeks after the end of the month. For example, the report for January, based on the water delivered to the distribution system from January 1 through January 31, should be in the District Office by February 15.

Promptness of reporting is emphasized because there is daily reference to these reports to answer questions from and furnish information to state and federal agencies, consulting engineering firms, suppliers of equipment and chemicals used in water supply, and to keep us better prepared to work with you toward the solution of problems of supply and operation of your own public water facilities.

Enclosed is a supply of Report Form No. 4955.10. There has been a slight revision so please discard all old forms left on hand. When your supply runs low a note with your next month's report will bring additional copies. Use as many as you like for your own records.

Included is a sample copy with data from a recent report on your supply, or estimated from data in our files. Due to the nature of Data Processing, we ask your cooperation in entering detail on your reports in a manner similar to that on the sample copy to avoid error in our Data Processing.

Identification Code
The identification code number is necessary on each report.

Report of Operations for the Month
The appropriate number for the month is 0 1 (Jan.) through 1 2 (Dec.) for the month during which the water was pumped to the distribution system, not the following month when the report is being written.

Population Served
The population is the most reasonable estimate of the number of people served by that distribution system.

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1/62

Total Number of Water Services

The number of service connections on that distribution system.

Total Output for Month (MG)

The number of million gallons (MG) entering the distribution system during the month designated in line 2, rounded off to the nearest thousand gallons in the third decimal of M.G.

Average Daily Output (MGD)

Total MG for the month divided by the number of days in the month.

Maximum Daily Output (MGD)

The MG served during the day of highest demand.

Estimated Works Capacity (MGD)

The most water, in MG, that can be served to that distribution system by the pumps or treatment plant, if this can be reasonably estimated.

Percent of Water from Surface Sources

The percent of all water entering the distribution system during the month which came from surface sources under your control.

Percent of Water from Ground Sources

The percent of all water entering the distribution system during the month which came from ground sources under your control.

Percent of Water from Other Water Works

To be used by those supplies which purchase water from another supplier. Those supplies whose entire source is from another supply would enter |1|0|0| in this field and zeros in the previous two lines regardless of whether the prime supplier uses surface or ground water. Those whose sources are under their own control should enter zeros in this field.

Average Chlorine Dosage (mg/l)

From the percentage of available chlorine in the chemical used, calculate the amount of chlorine fed during the month, and calculate the average milligrams per liter dosage by comparing the chlorine used to the gallons of water treated during the month. Calculate the dosage for each point of application and make entries in the appropriate lines; Pre, Intermediate, and Post.

Minimum Residual Chlorine at Entrance to Distribution System

Free

The lowest chlorine residual, by the "flash" test, in water entering the distribution system during the month.

Total

The lowest chlorine residual, by the 5 minute test, in water entering the distribution system during the month.

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Minimum Residual Chlorine at Extremities of Distribution System

Free

The lowest chlorine residual, by the "flash" test, in water at the extremities of the distribution system during the month.

Total

The lowest chlorine residual, by the 5 minute test, in water at the extremities of the distribution system during the month.

(Record all chlorine data to the nearest tenth of a milligram per liter. Any chlorine residual of 0.01 to 0.04 milligrams per liter should be recorded as $\boxed{0}\,.\,\boxed{T}$ which indicates a "Trace" of residual chlorine.

Number of Distribution System Samples Collected During Month for Bacterial Test

Record the total number of bacterial samples from the distribution system collected during the month designated in line 2, excluding repeat samples. Every effort should be made to include samples collected by county or state personnel. These results should be available to the person submitting the report.

Number of Samples Reported Unsafe

Enter here the number of the samples reported in above item which were found to be unsafe, regardless of who or what agency collected them.

Percent of Samples Unsafe

This item is now calculated by our computers. It is left on the form for those who wish to calculate the percentage for comparison with requirements outlined in the United States Public Health Service Drinking Water Standards.

To prevent figures getting recorded in the wrong field, we do ask that zeros be entered in spaces ahead of or after significant figures. In any field where the "information is not known" or "does not apply", please enter a dash ($\boxed{-}$) in each space.

Reports can be signed and submitted by anyone to whom the owner of the supply delegates the responsibility. However, th basic responsibility of the awareness that these reports are submitted correctly and promptly (by the 15th of the month following the end of the reporting period) to the District Office of this Department rests with the owner of the water system. The statutory authority for this requirement is contained in Sections 6111.13 and 6111.14 of the Revised Code of Ohio.

If there are any questions regarding these reports please feel free to contact this department at any time, or discuss them with someone from a nearby water supply.

Since it is necessary for this data to be compiled by the State Department of Health, we thank you for your cooperation in submitting these monthly reports on the operation of your water supply.

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Appendix A
1

Ohio Department of Health Policy on the Use of Form 4955.10 by Water Supplies Serving Municipalities, Sewer Districts, or Other Communities Through Master Meters, and Those Areas Being Served by Master Meters

So that we can properly interpret where there is duplication of totals on population served, number of services, gallonages, and distribution system sampling data. it will be necessary for these supplies to furnish each other the necessary information in those catagories.

We would like all reports to reach the District Office of the State Department of Health by the 15th of the following month.

Works Supplying Other Communities Through Master Meters

The main supply will report totals for all areas served by their works on population served, number of services, gallonages (as MG), and sampling data. They will include data on all bacterial samples collected in satellite distribution systems which are examined by laboratories other than their own.

They will supply each master-metered community with minimum chlorine residuals, the number of bacterial samples, the number of unsafe samples and the results of repeat samples taken monthly from that distribution area.

Satellites Served by Another Water Supply Through Master Meters

The master-metered community will report, for their own area, population served, number of services, total gallons for the month (as MG), average daily output (as MG), and bacterial sampling data for the month.

They will furnish the main supplies data on all bacterial samples collected in their distribution system which are examined by laboratories other than that of the main supplies.

Where it is impractical to obtain the appropriate information, the spaces on maximum daily gallonage and estimated capacity will be marked with dashes (-).

It should be noted that these communities are responsible for their distribution systems. There are numerous ways whereby a safe water can become contaminated in the distribution system. Therefore, for adequate control, it is strongly recommended that each community maintain their own program of checking chlorine residuals throughout the area served by them. Where residuals are being adequately maintained throughout the distribution system by the dosage applied by the supplier, dosages by the satellites would be reported as zero. Wherever the satellite has to use supplemental chlorination, these dosages will be reported as "post" chlorination.

They will keep the main supplier informed of significant changes in population served and number of services.

NOTE: To be recorded accurately by the data processing equipment, every square must have the appropriate number, zero (0), or dash (-). The dashes in any catagory report that "at present this information is not available."

Appendix A

REPORT OF OPERATION TO THE STATE DEPARTMENT OF HEALTH OF THE WATER SOFTENING PLANT AT Adams County Water Co. Inc.

DATE	WATER PUMPED FROM WELLS THOUSAND GALLONS	WATER SOFTENED THOUSAND GALLONS	HIGH SERVICE THOUSAND GALLONS	IRON REMOVAL DATA: NUMBER USED	IRON REMOVAL DATA: NUMBER WASHED	SOFTENER DATA: NUMBER USED	SOFTENER DATA: SOFTENER HOURS	SOFTENER DATA: NUMBER OF REGENERATIONS	SOFTENER DATA: THOUSAND GALLONS BETWEEN REGENERATIONS	CHEMICALS USED (Pounds): SALT	SODA ASH	SODIUM HYDRATE	SODIUM SILICATE		CHLORINE	ALKALINITY RAW	ALKALINITY TAP	HARDNESS RAW	HARDNESS TAP	pH RAW	pH TAP	IRON RAW	IRON TAP	CHLORIDE RAW	CHLORIDE TAP	RES. CHLORINE PLANT TAP	RES. CHLORINE SYSTEM TAP
1	NOT AVAILABLE	NOT AVAILABLE	METER NOT WORKING [illegible]			3		1	[illegible]	AVERAGE [illegible]			NOT IN SERVICE		6	280	220	360	109	7.2	7.0					.5	
2						3		1	[illegible]						6	260	270	360	99	7.2	7.0					.53	
3						3		[illegible]	[illegible]						6	180	270	400	99	7.0	6.9					.57	
4						3		[illegible]	[illegible]						5	280	300	400	99	7.3	7.2					.62	
5						3		[illegible]	[illegible]						5	310	300	400	109	7.1	7.0					.5	
6						3		[illegible]	[illegible]						6	270	300	400	109	7.1	7.0					.46	
7						3		[illegible]	[illegible]						7	290	280	360	99	7.2	7.0					.7	
8	[illegible]	[illegible]				3		[illegible]	[illegible]						[illegible]	[illegible]	[illegible]	[illegible]	109	7.2	7.0					.65	
9	[illegible]	[illegible]				3		[illegible]	[illegible]						[illegible]	[illegible]	[illegible]	[illegible]	99	[illegible]	6.7					.6	
10	[illegible]	[illegible]				[illegible]		[illegible]	[illegible]						[illegible]	[illegible]	[illegible]	[illegible]	99	7.1	7.0					.61	
11	[illegible]	[illegible]				[illegible]			[illegible]						[illegible]	[illegible]	[illegible]	[illegible]	99	7.1	7.0					.6	
12	[illegible]	[illegible]				[illegible]			[illegible]						[illegible]	[illegible]	[illegible]	[illegible]	99	7.2	7.0					.51	
13	[illegible]	[illegible]				[illegible]			[illegible]						[illegible]	[illegible]	[illegible]	[illegible]	109	7.2	7.1					.7	
14	[illegible]	[illegible]				[illegible]			[illegible]						[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]					[illegible]	
15	[illegible]	[illegible]				[illegible]			[illegible]						[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]					.6	
16	[illegible]	[illegible]				[illegible]			[illegible]						[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]					.62	
17	[illegible]	[illegible]				[illegible]			[illegible]						[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]					.61	
18	[illegible]	[illegible]				[illegible]			[illegible]						[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]					.7	
19	[illegible]	[illegible]				[illegible]			[illegible]						[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]					.5	
20	[illegible]	[illegible]				[illegible]			[illegible]						[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]					.6	
21	[illegible]	[illegible]				[illegible]			[illegible]						[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]					.5	
22	[illegible]	[illegible]				[illegible]			[illegible]						[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]					.45	
23	[illegible]	[illegible]				[illegible]			[illegible]						[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]					.4	
24	[illegible]	[illegible]				[illegible]			[illegible]						[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]					.65	
25	[illegible]	[illegible]				[illegible]			[illegible]						[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]					.6	
26	[illegible]	[illegible]				[illegible]			[illegible]						[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]					.29	
27	[illegible]	[illegible]				[illegible]			[illegible]						[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]					.6	
28	[illegible]	[illegible]				[illegible]			[illegible]						[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]					.6	
29	[illegible]	[illegible]				[illegible]			[illegible]						[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]					.65	
30	[illegible]	[illegible]				[illegible]			[illegible]						7	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]					.25	
31	[illegible]	[illegible]				[illegible]			[illegible]						[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]					.8	
	[illegible]	[illegible]				93		28							[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	217.9					18.6	
	[illegible]	[illegible]													[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	7.2	7.0					.6	

[illegible] .565 [illegible] .331

Month December Year 1971

Lloyd A Barrington 2-61-05 Operator

Superintendent

Appendix A

Report of Operation to the Department of Health, State of Ohio, for Water Purification Plant at Winchester

WATER TREATED	FILTER OPERATION		lbs		CHEMICALS USED lbs			CHEMICAL RESULTS IN PARTS PER MILLION: TURBIDITY	ALKALINITY					HARDNESS		pH		MAGNESIUM		CHLORINE	
330	3	1	100	150		8	7.0	5	78	77	17	67	10	112	137	8.0	8.5			0.5	0.1
366	3	1	100	100		8	7.0	5	76	75	17	65	11							0.8	
322	3	2	100	100	35		7.0	5	75	70	16	67	11							0.8	
294	3		100	100		8	6.0	5	75	70	16	65	11							0.8	
330	3	1	100	100		8	7.5	5	76	69	17	64	11							0.8	
302	3	2		100			6.5	5	75	68	16	65	10							0.8	
275	3	1	100	100			5.0	5	74	65	15	64	11	127	126	8.0	8.5			0.8	0.1
275	3		100	100		8	5.5	5	73	68	15	65	10							0.8	
287	3	1	100	100			6.0	5	72	65	14	63	11							0.8	
294	3	1		100		8	6.0	5	74	65	14	64	10							0.8	
292	3	1	100	100	35		6.0	5	76	75	13	70	10							0.8	
256	3	1	100	100		8	5.0	5	75	78	16	71	10							0.8	
256	3		100	100			5.0	5	76	75	15	71	10							0.8	
316	3	1		100		8	7.0	5	79	74	16	69	11	127	140	7.9	8.4			0.8	0.6
315	3		100	100			[illegible]	5	79	74	15	70	11							0.8	
286	3	1	100	100	35	8	[illegible]	5	77	73	16	68	10							0.8	
318	3	2	100	100			[illegible]	5	75	74	15	70	11							0.8	
264	3		100	100		8	[illegible]	5	86	74	16	73	12							0.8	
258	3			100		8	[illegible]	5	81	72	15	73	11							0.8	
[illegible]	3	1	100	50			[illegible]	5	78	73	16	73	12							0.8	
[illegible]	3	1	100	100			[illegible]	5	86	72	15	75	11							0.8	
290	3		100	100	35	8	[illegible]	5	78	72	15	73	11	126	127	8.0	8.5			0.8	0.1
283	3	1		100			[illegible]	5	[illegible]	[illegible]	16	73	12							0.8	
313	3	1	100	100		8	6.5	5	86	77	16	76	11							0.8	
[illegible]	3		100	100			[illegible]	5	77	75	13	74	10							0.8	
220	3			100		8	[illegible]	5	77	[illegible]	14	74	11							0.8	
280	3	1	100	100			[illegible]	5	80	75	14	72	11							0.8	
315	3	1	100	100	35	8	[illegible]	5	88	72	14	70	10							0.8	
322	3	1		100		8	7.0	5	79	76	14	75	12							0.8	
296	3	1	100	100			7.0	5	87	75	13	72	12	115	127	7.9	8.3			0.8	0.4
224	3		100	50		8	6.5	5	86	78	14	73	11							0.8	[illegible]
8,965		24	2800	3050	175	[illegible]	[illegible]	155	2444	2235	462	2195	336	604	667	795	922			24.8	1.2
289		0.77	91	98.5	5.6	[illegible]	6.3	5	79	72	14.5	71	10.8	121	133	8.0	8.4			0.8	0.24
356								5	88	78	17	79	12	127	140	8.0	8.5			0.8	0.6
[illegible]								5	72	65	13	63	10	112	126	7.9	8.3			0.8	0.1

3.1

December 1971

	2300		3050	175	136		194
	1.8		1.39	2.37	1.75		2.58

Mg/L

Charles Jones

James H. Meadows

OHIO DEPARTMENT OF HEALTH

RT ON THE BACTERIOLOGICAL EXAMINATION OF WATER AT [illegible] MONTH [illegible] YEAR

THE STANDARD TEST FOR THE PRESENCE OF MEMBERS OF THE COLIFORM GROUP BY THE MEMBRANE FILTER TECHNIQUE

	Raw Water										Filtered	Plant	Distribution System								
	A			B			C														
	Volume Filtered ml.	Total Colonies	Number of Coliform Colonies	Volume Filtered ml.	Total Colonies	Number of Coliform Colonies	Volume Filtered ml.	Total Colonies	Number of Coliform Colonies	No. of Coliforms Per 100 ml.	No. of Coliforms Per 100 ml.	No. of Coliforms Per 100 ml.	No. of Coliforms Per 100 ml. (Average)	No. of Samples Examined	Number of Coliforms Per 100 ml. in Samples Showing Typical Colonies					No. [illegible] forms Pe[illegible] in Repe[illegible] samples	
1							100	0	0	0	0	0	0	4	0	0	0	0	0	-	0
[illegible]							100	0	0	0	0	0	0	7	0	0	0	0	0		0
[illegible]												0	0	8	0	0	0	0	0		0
[illegible]							100	0			0	0	0	6	0	0	0	0	0	-	0
[illegible]							100	0	0	0	0	0	0	5	0	0	0	0	0	-	0

Coliform Density	Arithmetic Average	0	0	0	0	Dist. System
	Geometric Average	0	0	0	0	

Total No. of Samples Examined [illegible]

No. of Samples Exceeding 4 Coli. [illegible]

atory [illegible] Co.

ratory Approval No. ______

Signed [illegible]

Water Certificate No. [illegible]

REPORT ON THE BACTERIOLOGICAL EXAMINATION OF WATER AT Hillsboro, Ohio MONTH December 1971

THE CONFIRMED TEST FOR THE PRESENCE OF MEMBERS OF THE COLIFORM GROUP BY THE MULTIPLE-TUBE FERMENTATION TECHNIQUE

Date	Raw Water																			Filter Effluent				Plant Effluent				Finished Water in the Distribution System						
	Number of Tubes Showing Positive Results																		Most Probable Number (MPN)	Pos. Tubes			Most Probable Number (MPN)	Pos. Tubes			Most Probable Number (MPN)	Number of Samples	Pos. Tubes			Most Probable Number (MPN)	Most Probable Number of Each Sample Showing Confirmed Positive Results	Most Probable Number of Each Repeat Sample
	24 hr. Presumptive						48 hr. Presumptive						Confirmed							24 hr. Pres.	48 hr. Pres.	Confirmed		24 hr. Pres.	48 hr. Pres.	Confirmed			24 hr. Pres.	48 hr. Pres.	Confirmed			
	10.0	1.0	0.1	0.01	0.001	0.0001	10.0	1.0	0.1	0.01	0.001	0.0001	10.0	1.0	0.1	0.01	0.001	0.0001																
1	3	1	0				3	3	2				3	1	1				75	0	0		0	0	0		0	1	0	0		0		
2																																		
3																																		
4																																		
5																																		
6																												1	0	0		0		
7																																		
8	3	3	2				3	3	3				3	3	3				2400	0	0		0	0	0		0	1	0	0		0		
9																																		
10																																		
11																																		
12																																		
13																												1	0	0		0		
14																																		
15	3	2	1				3	3	3				3	3	3				2400	0	0		0	0	0		0	1	0	0		0		
16																																		
17																																		
18																																		
19																																		
20																												1	0	0		0		
21																																		
22	3	1	0				3	3	3				3	3	2				1100	0	0		0	0	0		0	1	0	0		0		
23																																		
24																																		
25																																		
26																																		
27																												1	0	0		0		
28																																		
29	2	1	0				3	3	1				3	2	1				150	0	0		0	0	0		0	1	0	0		0		
30																																		
31																																		

Series of Tubes used in Examination of Raw Water		Average MPN for the Month	Raw	Filtered	Plant	System	Total No. of Distribution System Samples Examined No. of System Samples with 3 or more Tubes Positive	

Laboratory Hillsboro Water Works

Laboratory Approval No. 93

(10 W18-62)

Signed Joseph M. Freunt

Water Certificate No. 2-67-16

OHIO DEPARTMENT OF HEALTH

COMPARISON STUDY OF THE MEMBRANE FILTER AND MULTIPLE-TUBE FERMENTATION PROCEDURES

MONTH *December* YEAR 19-

RAW WATER ☑ FINISHED WATER ☐

DATE	THE MULTIPLE-TUBE FERMENTATION TECHNIQUE																				THE MEMBRANE FILTER TECHNIQUE									
	Number of Tubes Showing Positive Results																		Most Probable Number (MPN)	95 Percent Confidence Limits	A			B			C			No. of Coliforms Per 100 ml.
	24 Hr. Presumptive						48 Hr. Presumptive						Confirmed																	
	10.0	1.0	0.1	0.01	0.001	0.0001	10.0	1.0	0.1	0.01	0.001	0.0001	10.0	1.0	0.1	0.01	0.001	0.0001			Volume Filtered ml.	Total Colonies	Number of Coliform Colonies	Volume Filtered ml.	Total Colonies	Number of Coliform Colonies	Volume Filtered ml.	Total Colonies	Number of Coliform Colonies	
1	3	1	0				3	3	2				3	1	1				75		1.0	4	1	10.0	76	3	20.0	168	5	52
2																														
3																														
4																														
5																														
6																														
7																														
8	3	3	2				3	3	3				3	3	3				2400		1.0	149	4	10.0	TMC	26	20.0	TMC	35	285
9																														
10																														
11																														
12																														
13																														
14																														
15	3	2	1				3	3	3				3	3	3				2400		1.0	23	1	10.0	267	17	20.0	TMC	16	23
16																														
17																														
18																														
19																														
20																														
21																														
22	3	1	0				3	3	3				3	3	2				1100		1.0	1	0	10.0	17	1	20.0	60	3	13
23																														
24																														
25																														
26																														
27																														
28																														
29	2	1	0				3	3	1				3	2	1				150		1.0	1	0	10.0	12	0	20.0	24	0	0
30																														
31																														

Laboratory *Hillsboro Water Works*

Laboratory Approval No. *93*

Signed *Joseph M. Frum*

Water Certificate No. *2-67-16*

1336.10

OHIO DEPARTMENT OF HEALTH
WATER SUPPLY WORKS DATA SHEET

NAME OF WATER SUPPLY ______________________________

Address ______________________________

County

Persons Contacted

Additional Notes on Supply

Identification Code	1 2 3 4 5 6 7 8 9
Population Served	10 11 12 13 14 0 0
Number of Service Connections	15 16 17 18 19 20
Source of Water	21
Number of Wells (if ground supply)	22 23
Estimated Safe Yield m.g.d	24 25 26 27 28 29
Type of Plant – (if any)	30 31
Treatment	32 33 34 35 36 37 38 39 40
Works Capacity m.g.d.	41 42 43 44 45 46
Average Works Output m.g.d.	47 48 49 50 51 52
Clearwell Storage m.g.	53 54 55 56
System Storage m.g.	57 58 59 60
Year Placed in Service	61 62
Year of Latest Improvement	63 64
Works Classification	65
Laboratory Control Rating	66
Bacterial Quality Control Rating	67
Chemical Quality Rating	68
Status of Technical Supervision	69
Status of Monthly Operating Reports	70
Improvements Needed	71
Overall Rating	72
Date of this Inspection	73 74 75
Engineer making Inspection	76 77 78

4964.10 12/65

PHYSICAL WATER SUPPLY DATA SHEET

In filling in the data sheet, the name of the water supply, proper mailing address, and county are to be written on the first three lines. The name of the person contacted and his title should also be given. Any additional notes, information or comments should be included to give full evaluation of the works and supply.

An "0" should be used to indicate "none" or "zero." Spaces not used for data should be filled in using "0." For example, a water plant having an average works output of 1,600,000 gallons per day should be recorded as 001.600 m.g.d., system storage of 270,000 gallons would be recorded as 00.27 m.g. If data is not available the spaces should be filled in with a dash.

The first 9 spaces on all data cards are filled in as follows:

Spaces 1 to 5 Are the federal (and state) place identification code.

Spaces 6 and 7 Are the type of case identification which, in this instance, is water supply coded as "01."

Spaces 8 and 9 Are the number of case at this particular location such as, 01, 02, 03, 04 which would, for example represent the four Cleveland purification plants.

Spaces 10 to 14 - Population Served. This number represents the total number of users of this particular water supply. This will probably be greater than the recorded population of the municipality. The figure is recorded to the nearest hundred, omitting the unit and tens digits.

Spaces 15 to 20 - Service Connections. The number of service connections.

Space 21 - Source of Supply. From the following sources select the one which most nearly describes the supply.

1. Ground (wells, etc.)
2. Surface streams
3. Lake, reservoir or impoundment
4. Up-ground storage
5. Combination ground and stream
6. Combination ground and reservoir
7. Combination ground and up-ground storage
8.
0. Other

Spaces 22 and 23 - Number of Wells

In these spaces record the number of wells and if any, which are equipped for use in producing water for this supply.

Spaces 24 to 29 - Safe Yield

Determine in million of gallons per day the considered dependable safe yield for the system under adverse conditions. This includes well production, available stream flow or quantity withdrawn from storage in gallons per day. Record the figures in millions of gallons per day (m.g.d.) to three decimals. For example, 350,000 g.p.d. should be recorded as 000.350.

Spaces 30 and 31 - Type of Plant (if any)

The Conference of State Sanitary Engineers and the U. S. Public Health Service has suggested that the type of treatment plant be designated in their data forms.

P - Purification Plants (surface water
H - Softening Plants (lime soda and ion exchange)
I - Iron and Manganese Removal

Spaces 32 to 40 -

O - None
A - Aeration
C - Chemical Treatment (Coagulation)
D - Disinfection
F - Filtration
K - Stabilization
L - Lime-Soda Softening
M - Mixing Device or Mixing Tank
N - Ammoniation
R - Recarbonation
S - Sedimentation
T - Taste and Odor Control
V - Fluoride Adjustment
Z - Ion Exchange Softening

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The letters should be inserted from left to right starting with space 32. Any unused spaces should be filled in with dashes. If there is no treatment, insert "O" in space 32 and fill in all remaining spaces with dashes.

Spaces 41 to 46 - Works Capacity

Indicate in million gallons per day the capacity of works as determined by a limiting factor such as pumping capacity, settling capacity, filter capacity or other limiting unit. The capacity is recorded in m.g.d. to three decimals.

Spaces 47 to 52 - Average Works Output

From plant operating records the average daily output for the preceding year is determined and recorded in m.g.d. to three decimal places. For example, an average daily output of 2,210,000 would be recorded 002.120.

Spaces 53 to 56 - Clear Well Storage

Record the total clear well storage of finished water available to the high service pumps. Use million gallons to two decimals.

Spaces 57 to 60 - System Storage

Record sum of all storage on the distribution system in m.g. to two decimals.

Spaces 61 and 62 - Year Placed in Service

Record last two digits of year plant or system was placed in service.

Spaces 63 and 64 - Year of Last Major Improvement

Record last two digits of year of last major improvements such as plant enlargements, new filters, etc.

Space 65 - Works Classification

In this space indicate the type of classification as determined by the rating system set up by the Advisory Committee to the Board of Examiners.

Space 66 - Laboratory Control Rating

Indicate whether satisfactory laboratory arrangements have been made. If the plant operates in own laboratory it should be approved by the Ohio Department of Health laboratory staff.

1. Satisfactory and approved
2. Unapproved and unsatisfactory
3. Improvements underway
4.
0. No laboratory control.

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Space 67 - Bacterial Quality Rating

1. Satisfactory

(a) Bacteriological analyses all performed by a laboratory approved by the Ohio Department of Health.

(b) The number of samples collected for bacteriological analyses is in accordance with recommendations of the Ohio Department of Health.

(c) The standard sample for the bacteriological test consists of at least five 10 ml portions in the fermentation tube test or not less than 50 ml in the membrane filter test.

(d) The average coliform density of all samples examined per month does not exceed one per 100 ml.

(e) When the coliform density in a single sample exceeds a recommended limiting value, repeat sampling is performed in accordance with recommendations of the Ohio Department of Health.

2. Provisional

(a) Bacteriological analyses are performed by a laboratory not approved by the Ohio Department of Health.

(b) The number of samples collected each month for bacteriological analysis is less than the recommended number but is not less than 50% of the recommended number.

(c) Repeat sampling is not performed in accordance with recommendations of the Ohio Department of Health.

3. Unsatisfactory

(a) There is no bacteriological sampling performed.

(b) The number of samples examined per month is less than 50 % of the recommended number.

(c) The average coliform density of all samples examined per month exceeds one per 100 ml.

Space 68 - Chemical Quality Rating

In indicating appraisal of chemical quality use hardness, iron, manganese, sulphur, methan gas, turbidity or other physical constituents as criteria. Potable water should be clear, clean sparkling free of taste and odor. These physical qualities are related to and are a part of the chemical quality of the water.

1. Satisfactory chemical quality
2. Unsatisfactory chemical quality
3. Some improvement needed

Space 69 - Status of Technical Supervision

This item indicates compliance or non-compliance with the Department requirements for supervision of the system.

1. Satisfactory
2. Unsatisfactory
3. Provisional
0. Not required

Space 70 - Operating Reports

Indicate whether current satisfactory monthly operating reports are being received.

1. Satisfactory
2. Unsatisfactory
3.
0. Not required

Space 71 - Improvements Needed

List most important improvements needed.

1. Additional supply
2. Plant enlargement and improvement
3. Finished water storage
4. Distribution
5. Additional supply and plant improvement
6. Additional supply and distribution
7. Additional plant and distribution
8. Operational Improvements
0. None

Space 72 - Overall Rating

This the overall evaluation of the plant in the opinion of the visiting engineer.

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Space 72 - Overall Rating (continued)

1. Excellent
2. Very Good
3. Good
4. Fair
5. Poor

Spaces 73 to 75 - Date of Inspection

List month and year of this complete inspection which has included the collection of chemical samples. Please note, however, that the months are given in Space 73 beginning with January as month number "1",

October is month "O"
November is month "X"
December is month "R"

This saves one space on the data card. For example, a visit made February 10, 1962, is coded 262. A visit made in December 1965 is coded R65.

Spaces 76 to 78 - Engineer Identification

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PROPOSED RATING VALUES FOR THE CLASSIFICATION OF WATER SUPPLY WORKS

	Unit	Rating Value
Source -	Ground Water	3
	Surface Supply	5
	Surface Supply with Reservoirs	6
Quality -	Less than 1.0 coliform per 100 ml.	2
	1.0 to 100 " " " "	4
	100 to 1000 " " " "	6
	1000 to 5000 " " " "	8
	5000 to 20000 " " " "	10
	More than 20000 " " " " (maximum monthly average)	12
Treatment -	A- Aeration	2
	C- Coagulation (Surface water only)	10
	S- Sedimentation	5
	F- Filtration	10
	D- Disinfection	5
	Z- Ion Exchange	5
	Y. Adsorption	2
	Z. Chemical Oxidation	2
	L- Chemical Precipitation (Softening)	6
	K Stabilization	2
	V Fluoridation	2
Distribution -	Raw Water Pumping	5
	Receiving Basins or Reaction Tanks	1
	Finished Water Pumping	5
	Finished Water Storage at Plant	1
	Storage on the System	2
Pumpage -	One unit per 0.1 M.G.D. (average)	1 -- 50

CLASSIFICATION

Class I - - - - - - - - - - - -	1 - 50
Class II - - - - - - - - - - - - -	51 - 75
Class III - - - - - - - - - - -	76 - 100
Class IV - - - - - - - - - - -	101 or more

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6/5/63.

Appendix B

Water Quality

1. Collection of Water Samples for Chemical Analysis 140

2. Hazardous Substances in Drinking Water 141

3. Need for Expanded Laboratory Services in Chemical Analyses of Drinking Water 147

4. Water Quality Data 156

5. Bacteriological Examination of Water 160

6. Laboratory Approval Program for Control of Water Quality 164

7. U.S. EPA Survey of Water Chemistry Laboratory 168

JAMES A. RHODES, Governor

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Director of Health

450 East Town Street
P.O. Box 118
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State of Ohio

Department of Health

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Appendix B
1

TO: Water Works Superintendents, Operators and Chemists

FROM: A. L. Fishback, Engineer-in-Charge, Water Supply Unit

SUBJECT: Collection of Water Samples for Chemical Analyses

The potential hazards of trace elements to the public water supplies of this state indicates a need for strengthening the program on chemical analyses of drinking water supplies.

We are proposing to meet this need by increasing the frequency of sampling for chemical analysis and expanding the routine chemical analysis to include additional tests for trace elements. The following program is proposed:

1. The responsibility for collection of samples will be placed on the owner of the water supply system.
2. All public water supplies taken from surface sources will be sampled every three (3) months.
3. All public water supplies taken from ground water sources will be sampled once each year.
4. The sample will consist of a grab sample representative of the water entering the water distribution system.
5. Public water supplies suspected of containing substances hazardous to health will be sampled at more frequent intervals.

We seek your assistance and cooperation in the collection of the samples and the sending of the samples to the laboratory of this department for chemical analysis. Each water works will be notified when a sample is to be collected and will receive the necessary sampling bottles and shipping containers. It is expected that the water works will pay the cost of shipping the samples to the state laboratory in Columbus.

The sample should be collected from a tap at the entrance to the distribution system. If the water is treated the sample should be the finished water at the plant. If no treatment is provided the sample would be collected from the well or the first tap after the water enters the distribution system. We are seeking a sample of water that is representative of the water that the consumer will be drinking.

A copy of the report of water analysis will be sent to the water works as soon as the analyses are completed. If there are questions on the above procedures, please contact the Water Supply Unit, Ohio Department of Health, telephone number is 614 469 - 4994.

Appendix B
2

Hazardous Substances in Drinking Water

The importance of providing safe drinking water is essential because of the direct health effects it has on large numbers of people who consume it daily. Concern for the quality of drinking water has until recently centered principally on the danger of waterborne disease outbreaks caused by bacteriological contamination.

However, a growing roster of trace metals, organic and inorganic chemicals, and an almost countless number of other toxic substances greatly emphasizes the potential of such substances being present in drinking water and the need for constant surveillance by qualified public health personnel. In addition, the acute and chronic low level effects of all chemical substances are not known.

These potential health hazards added to a lack of historical data as to their occurrence, plus difficulties in identifying such substances, and little knowledge of the effects of treatment processes, has created a need for constant vigilance and application of the best techniques of water treatment and distribution by responsible public health officials.

In discussing these potential health hazards it is necessary to consider the following types of substances.

I. BIOLOGICAL
Bacteriological and Virological

There is a recognized need for new rapid techniques for identification of bacterial health hazards in water. There is also an urgent need for direct and efficient methods for quantitation of Salmonella, Shigella, Vibrio Leptospira and other pathogenic type organisms. There is no satisfactory method now available for the detection of viral organisms. This is necessary in order to make available standard virologic methods for water quality examination, re-evaluate the efficiency of conventional water treatment processes and to ascertain the validity of bacterial indicator systems used today in relation to viral pollution under different conditions. Solutions to these problems are best handled by people thoroughly familiar with such potential health hazards and their potential effect.

II. PHYSICAL

Substances causing turbidity color, odor and taste problems frequently are the source of complaints and are aesthetically displeasing, as well as having potential health effects.

III. CHEMICAL

During the past decade, science and industry have developed and manufactured a great variety of new products. Many of these substances carry along with them certain threats to health and wellbeing and consequently their hazard to public health when encountered in drinking water must be evaluated. The presence of such substances is indicative of the need for qualified public health personnel.

Organics

The toxicity of a few of these has been studied substantially; however, the available information on the toxicity of most of these chemicals is quite meager. There is an obvious need for pertinent toxicity data relating this group to detrimental effects on human health and derivation of drinking water standards for organics other than pesticides.

Inorganics and Heavy Metals

Heavy metal salts in solution constitute a very serious form of pollution since they are stable compounds, not readily removed by oxidation, precipitation or other natural process. A characteristic feature of heavy metal pollution is its persistence in time as well as in space. The fact that such materials are concentrated to varying degrees adds to the concern. Some of the metal-organic complexes may be even more toxic than the metal ion itself as in the case of methyl mercury.

The lack of understanding of the total overall long term effects of such inorganics on human health has made it most difficult to attach the proper significance to such materials when consumed for long periods of time at low levels, as may be found in public drinking water supplies. Again the need for qualified public health personnel to evaluate the effects of such substances is obvious.

IV. RADIOACTIVITY

The effects of human radiation exposure are viewed as harmful and any unnecessary exposure to ionizing radiation should be avoided. Radiological health personnel are aware of the hazards involved.

SOURCES OF HAZARDOUS SUBSTANCES

The sources of substances which may be hazardous to health are many because public water supplies commonly involve processing of water to improve its quality. The initial source of contamination is logically the raw water. This however, is not the only source of contamination.

Water treatment chemicals are another source. All treatment chemicals must be studied and approved before use. Open finished water storage reservoirs, distribution systems, water main breaks, and cross connections are still other potential sources of contamination, pointing out the need for personnel thoroughly trained in public health engineering.

OCCURRENCES OF HAZARDOUS SUBSTANCES

Causes of suspected waterborne disease outbreaks in Ohio since 1946 at public water supplies have been attributed to interruption of disinfection and cross connections.

Monitoring for nitrate nitrogen (cause of methemoglobinemia in infants) at drinking water supplies in Ohio was begun in July, 1947. Consistently high nitrate nitrogen concentrations have not been found in public water supplies, although it is suspected that some inadequately protected rural water supplies do have high concentrations of nitrate nitrogen. Advice and warnings in these cases are given by health department officials.

Routine analyses for fluoride do not indicate any fluoride levels above the standard at drinking water supplies with controlled fluoridation. Many supplies without controlled fluoridation, however, have a natural fluoride content which exceeds the standards causing potential health problems.

Analysis for heavy metals began routinely in October, 1970, following reports of mercury in Lake Erie the previous spring. Of the twelve metals analyzed for regularly, barium has been found to persist in concentrations exceeding the 1962 United States Public Health Service mandatory limit at, at least, one public water supply. The discovery of chromium in another water supply led to abandonment of one of its wells. In addition, investigations have been made for suspected concentrations of lead, copper, nickel and zinc. Requests have been made to begin testing routinely for eighteen additional trace chemicals as well as inclusion of pesticides and radioactivity.

CONCLUSIONS

Even though wastewater control efforts will be expanded in the future and are sorely needed to minimuze future pollution of our drinking water sources, it is clear that water pollution control efforts alone cannot assure a safe drinking water quality. It is highly unlikely that even the best conventional waste treatment will produce an effluent of drinking water quality. As such, waste treatment does not remove all of today's known potential toxicants or biologic agents prior to discharge. In addition, there are known pollutants from runoff and spills which have an effect on source drinking water which are not subject to waste treatment. Unlike wastewater treatment, accidental spills and by-passing at water treatment plants could be catastrophic.

For these reasons, and because of the direct health effects, such hazardous substances may have on large numbers of people, it is imperative that the control of drinking water supplies be in the hands of public health officials. The investigation of waterborne disease outbreaks and chemical contamination are best conducted by public health personnel, so that we may benefit from past mistakes and change procedures, so that such instances will not re-occur for the same reasons. Delivery of adequate supplies of safe water at the consumer's tap will be dependent upon constant surveillance of the finished water by qualified public health personnel and properly designed, constructed and operated water treatment plants and distribution systems.

Appendix B

3

REPORT ON THE NEED FOR EXPANDED LABORATORY SERVICES IN THE CHEMICAL ANALYSES OF DRINKING WATER

December 18, 1970

The increasing pollution of the rivers, lakes and streams of Ohio by a wide variety of contaminants requires that the laboratory services available to the Water Supply Unit, Division of Engineering be expanded to provide the necessary capability for detection of contaminants that may be present in concentrations hazardous to health. This report describes the present status of the laboratory program and lists immediate and future requirements for laboratory service to meet these challenges.

PRESENT STATUS

There are three general types of sampling programs followed by the Water Supply Unit: (1) Samples collected by engineers during inspection of public water supply systems (2) Samples submitted by water purveyor for routine monitoring of drinking water quality and (3) Special samples for fluoride monitoring, new sources of supply, sand analyses, and special investigations. A routine set of chemical analyses are performed on engineer's inspection samples and monitoring samples.

Engineer's Inspection Samples.

These are samples collected by the engineer during his annual inspection of public water supply systems. The number of samples collected from each of the 700 public water supply systems will vary depending on the number of raw water sources and the treatment provided. This will average about 1½ to 2 samples per inspection for a total of about 1200 samples per year or about 25 samples per week.

The sample containers are supplied by the Division of Engineering from central storage at Chesapeake Avenue offices.

Routine Monitoring Samples.

On October 1, 1970 the Water Supply Unit initiated a program for regular sampling of drinking water at all public water supply systems. This provided for sampling of drinking water from approximately 150 surface water supplies every three months and approximately 550 ground water supplies once each year. The water purveyor was assigned the responsibility for collection of the samples and sending to the Bureau of Laboratories in Columbus. Sampling of surface water supplies began on October 1, 1970 at the rate of 15 samples per week. Sampling of ground water supplies is scheduled to begin on January 1, 1971 at the rate of 15 samples per week. The total number of monitoring samples will be about 30 samples per week.

The sampling containers are prepared and shipped to the water purveyor by the Bureau of Laboratories on a schedule set by the Water Supply Unit. The sampling containers are taken from central storage at the Chesapeake Avenue offices. Instructional material for inclusion with the sample kit is supplied by the Water Supply Unit.

Special Samples.

Fluoride Monitoring. Public water supply systems with controlled fluoridation are required to submit a monthly sample of treated water for fluoride analysis by the Bureau of Laboratories. At the present time 44 samples are submitted each month. This will average about 10 samples per week.

Sample containers are supplied by the Bureau of Laboratories.

New Wells. The District Engineer collects samples from each new well intended as a source of supply for public water supply systems. This will total about 100 samples a year or about two samples per week. A routine chemical analysis is performed on each sample.

Sieve Analyses. Samples of sand intended for use in rapid sand filters at water treatment plants are submitted to the Bureau of Laboratories for sieve analysis. The number of samples averages about 50 per year or one sample per week.

Special Investigations. Samples are collected during special investigations. The recent mercury problem thrust an unusually heavy load on the laboratory staff. Similar incidents concerning chromium and chloride contamination have occurred in the past few weeks. Samples of this type are characterized by the need for fast accurate analyses.

Routine Analyses.

The following routine analyses are performed on all engineer's inspection samples, routine monitoring samples, and samples from new wells.

Turbidity
Color
pH
$CaCO_3$ Stability
Alkalinity

Hardness
Total Solids
Sulfate
Chloride
Fluoride

Calcium
Magnesium
Sodium
Potassium
Iron
Manganese

In addition, all samples of water entering the distribution system (finished water) are analyzed for:

Nitrate
Cadmium
Chromium
Copper
Lead
Nickel
Silver
Zinc

Special Analyses.

The engineer may request special analyses on water samples. These may include any of the following:

Odor
Conductivity
Ammonia
Nitrites
Sulfide
Total Carbon
MBAS
Phenol
Cyanide
Oil
Tannin
Aluminum
Mercury

Microscopic examinations, determinations of the chemical composition of substances, pesticide analyses, jar tests may be requested.

IMMEDIATE NEEDS

(1) As of January 1, 1971 the routine monitoring program for public water supplies should be expanded to cover ground water supplies at the rate of 15 samples per week.

(2) As of January 1, 1971 all samples submitted for routine water analysis should be analyzed for trace metals and nitrates.

(3) As soon as possible, the routine water analyses should be expanded to include the following analyses:

Conductivity
Arsenic
Barium
Mercury
Boron
Aluminum
Phenol
Selenium
Phosphate
Cyanides

(4) There is a need for routine analyses of the organics in water. Steps should be taken to determine procedures and equipment needs for organic analyses.

(5) There is a need for routine pesticide analyses. Steps should be taken to determine procedures and equipment needs.

(6) There is a need for automation of routine chemical analyses. The use of an "Autoanalyzer" should be investigated.

(7) The laboratory should make preparation for receiving an additional 80 fluoride monitoring samples each month as a result of the new fluoridation law.

(8) Procedures and equipment should be studied for inclusion of radioactivity analyses as a routine water analysis.

FUTURE NEEDS

(1) During 1971 the laboratory should develop the capability for performance of the following trace metal analyses and gradually incorporate these analyses in the routine examination of water.

Beryllium
Strontium
Titanium
Uranium
Vanadium
Antimony
Tin
Molydenum
Cobalt
Lithium
Tungsten
Zirconium

(2) During the summer of 1971 all surface water supplies (150) should be examined for pesticides. During 1972 all ground water supplies (550) should be examined for pesticides.

(3) By January 1, 1972 the laboratory should have the capability for scanning for organics on a routine basis. During 1972 all surface water supplies should be scanned for organics. This should be extended to ground waters in 1973.

(4) There is a need for inspection of water works laboratories to determine if the chemical analyses performed by these laboratories are in compliance with Standard Methods. This would be a program similar

to the bacteriological laboratory survey that has been carried out for the past ten years.

(5) By January 1, 1972 routine analyses for radioactivity should be made on surface water monitoring samples. By 1973 this should be expanded to ground water monitoring samples.

SCHEDULE OF CHEMICAL ANALYSES
TO BE PERFORMED ON A WEEKLY BASIS

	Present	As of 1-1-71	As of 1-7-71	As of 1-1-72	As of 1-1-73	As of 1-1-74
Turbidity	42	57	60	65	70	
Color	42	57	60	65	70	
pH	42	57	60	65	70	
$CaCO_3$ Stability	42	57	60	65	70	
Alkalinity	42	57	60	65	70	
Hardness	42	57	60	65	70	
Total Solids	42	57	60	65	70	
Sulfate	42	57	60	65	70	
Chloride	42	57	60	65	70	
Fluoride	53	74	75	135	140	
Calcium	42	57	60	65	70	
Magnesium	42	57	60	65	70	
Sodium	42	57	60	65	70	
Potassium	42	57	60	65	70	
Iron	42	57	60	65	70	
Manganese	42	57	60	65	70	
Nitrate	30	57	60	65	70	
Cadmium	30	57	60	65	70	
Chromium	30	57	60	65	70	
Copper	30	57	60	65	70	
Lead	30	57	60	65	70	
Nickel	30	57	60	65	70	
Silver	30	57	60	65	70	
Zinc	30	57	60	65	70	

SCHEDULE OF CHEMICAL ANALYSES
TO BE PERFORMED ON A WEEKLY BASIS

	Present	As of 1-1-71	As of 7-1-71	As of 1-1-72	As of 1-1-73	As of 1-1-74
Conductivity	--	--	60	65	70	
Arsenic	--	--	60	65	70	
Barium	--	--	60	65	70	
Mercury	--	--	60	65	70	
Boron	--	--	60	65	70	
Aluminum	--	--	60	65	70	
Phenol	--	--	60	65	70	
Selenium	--	--	60	65	70	
Phosphate	--	--	60	65	70	
Cyanides	--	--	60	65	70	
Organics (Scanning)	--	--	--	70	35	70
Radioactivity	--	--	--	15	35	70
Aldrin	--	--	15	30	35	70
DDD	--	--	15	30	35	70
DDE	--	--	15	30	35	70
DDT	--	--	15	30	35	70
Dieldrin	--	--	15	30	35	70
Chlordane	--	--	15	30	35	70
Endrin	--	--	15	30	35	70
Heptachlor	--	--	15	30	35	70
Heptachlor Epoxide	--	--	15	30	35	70
Lindane	--	--	15	30	35	70

SCHEDULE OF CHEMICAL ANALYSES
TO BE PERFORMED ON A WEEKLY BASIS

	Present	As of 1-1-71	As of 1-7-71	As of 1-1-72	As of 1-1-73	As of 1-1-74
Methoxychlor	--	--	15	30	35	70
Malathion	--	--	15	30	35	70
Parathion	--	--	15	30	35	70
Methyl Parathion	--	--	15	30	35	70
Beryllium	--	--	60	65	70	
Strontium	--	--	--	65	70	
Titanium	--	--	60	65	70	
Uranium	--	--	60	65	70	
Vanadium	--	--	60	65	70	
Antimony	--	--	60	65	70	
Tin	--	--	--	65	70	
Molybdenum	--	--	--	65	70	
Cobalt	--	--	--	65	70	
Lithium	--	--	60	65	70	
Tungsten	--	--	--	65	70	
Zirconium	--	--	--	65	70	

Appendix B

4

Ohio Department of Health

Instructions for Filling Out Water Quality Data Sheet

1. Date Received - Date that the sample is received at the laboratory
2. Date Reported - Date that the analysis is completed by the laboratry.
3. Laboratory Number - Number is assigned by laboratory personnel for laboratory purposes.
4. Analyst - Person(s) performing the analysis.
5. Laboratory - Laboratory at which the analysis is performed. Assumed to be the Central Laboratory in Columbus if left blank.
6. Station - Name of the sampling station (water plant, wastewater plant, industry, stream, etc.)
7. Station Code - Identification number assigned to the sampling station by the Division of Engineering.
8. County - Name of county in which sample was collected.
9. Collected By - Name of person collecting the sample.
10. Identification of Sample - Specific location of sampling point - plant tap, Smith residence, outfall #2, etc.
11. Sample Code - This block is used to further identify the nature of the sample type as follows:

    Water Supply Samples, code as;

    1 - Raw or untreated water at the source of supply.

    2 - Treated water at the plant or entrance to the distribution system.

    3 - Treated or untreated water in the distribution system.

    Industrial Waste Samples, code as;

    A - Paper Mill

    B - Power Plant

C - Metal Finishing Plant

D - Steel Mill

E - Chemical Plant; Inorganic

F - Chemical Plant; Organic

G - Refinery; Oil Producer

H - Food Processer; Brewery

I - Acid Mine Drainage

J - Sand and Gravel Producer

K - Tannery; Rendering Plant

L - Coal Washer

M - Industrial Sewage

N - Miscellaneous

12. Date of Grab Sample - (or last date of composite sample) - year month, day, hour, minute.

13. Composite Type - Describes the nature of the composite as follows:

First Block
S - Space composite (volumetric proportions).
T - Time composite (time proportions).
B - Samples that are both space and time composites.

Second Block
Leave Blank - Composite samples for which a single set of analyses are made after the compositing process has been completed.
Code A - Computed average value of several individual samples or average value of a continuous record.
Code H - Maximum value of several individual samples or the maximum value of a continuous record.
Code L - Minimum value of several individual samples or minimum value of a continuous record.

14. Sample Type - Indicate by checking the block.

15. Analysis to be Reported to: - Check the block indicating which office the results are to be sent.

16. Beginning Date of Composite Sample - Year, month, day, hour, minute.

17. Frequency - Describes the frequency of a composite sample as follows:

- For samples collected continuously, code the first block with "C" and leave the second block blank.
- For a composite sample made up of individual grab samples, the number of which is not to be reported, code the first block with "G" and leave the second block blank.
- A two-digit number such as 04 or 12, is used to report the number of grab samples comprising a composite sample.
- Both blocks can be left blank when none of the above information is to be recorded.

18. Additional Information - Reason for Taking Sample - Remarks by Analyst - Comments to be made as necessary.

19. Regular - Check this box for water supply samples which are to be analyzed for the routine set of parameters.

Check the box next to each analysis requested.

The laboratory should always be contacted regarding special samples, preservation and "emergency" analyses.

157

Date Received

OHIO DEPARTMENT OF HEALTH

WATER QUALITY DATA

Laboratory Number

Date Reported

Laboratory

Analyst

Station

Station Code ☐☐☐☐☐

County

Collected by

Identification of Sample

Sample Code ☐

Date of grab sample (or last date of composite sample) — Year Month Day Hour Minute ☐☐☐☐☐

Composite Type ☐☐

Sample Types: ☐ Industrial ☐ Sewage ☐ Water Supply ☐ Stream

Beginning Date of Composite Sample — Year Month Day C Hour Minute ☐☐☐☐☐

Frequency ☐☐

Analysis to be Reported to: ☐ CO ☐ SEDO ☐ NEDO ☐ SWDO ☐ NWDO

REASON FOR TAKING SAMPLE – ADDITIONAL INFORMATION – REMARKS BY ANALYSIS:

☐ Regular (or indicate by checking boxes)		Fluoride Diss, F	mg/l	Cyanide, CN	mg/l
☐ Flow	CFS	Calcium Total, Ca	mg/l	MBAS	mg/l
☐ Water Temperature, Field	C°	Magnesium Total, Mg	mg/l	Oil-Grease, Total	mg/l
☐ pH, Field	S. U.	Potassium Total, K	mg/l	Phenols	ug/l
☐ Dissolved Oxygen, Field	mg/l	Sodium Total, Na	mg/l	Tannin Lignin	mg/l
☐ Hydrogen Sulfide, Field	mg/l	Aluminum Total, Al	ug/l	Aldrin, Whl Smpl	ug/l
☐ Chlorine Free Avl, Field	mg/l	Antimony Total, Sb	ug/l	DDD, Whl Smpl	ug/l
☐ Chlorine Tot Resd, Field	mg/l	Arsenic Total, As	ug/l	DDE, Whl Smpl	ug/l
☐ Color	Pt-Co Units	Barium Total, Ba	ug/l	DDT, Whl Smpl	ug/l
☐ Odor	T. N.	Beryllium Total, Be	ug/l	Dieldrin, Whl Smpl	ug/l
☐ Turbidity	J. U.	Bismuth Total, Bi	ug/l	Chlordane, Whl Smpl	ug/l
☐ Conductivity at 25 C°	Micromhos	Boron Total, B	ug/l	Endrin, Whl Smpl	ug/l
☐ pH, Lab	S. U.	Cadmium Total, Cd	ug/l	Heptachlor, Whl Smpl	ug/l
☐ pH, $CaCO_3$ Stability	S. U.	Chromium Total, Cr	ug/l	Hptchlr-Epoxide, Whl Smpl	ug/l
☐ Alkalinity Total, $CaCO_3$	mg/l	Chromium Hex, Cr	ug/l	Lindane, Whl Smpl	ug/l
☐ Alkalinity Phth, $CaCO_3$	mg/l	Cobalt Total, Co	ug/l	Methoxychlor, Whl Smpl	ug/l
☐ Alkalinity, $CaCO_3$ Stabl	mg/l	Copper Total, Cu	ug/l	Malathion, Whl Smpl	ug/l
☐ Carbon Dioxide, CO_2	mg/l	Iron Total, Fe	ug/l	Parathion, Whl Smpl	ug/l
☐ Acidity Total, $CaCO_3$	mg/l	Iron Diss, Fe	ug/l	Methyl Parathn, Whl Smpl	ug/l
☐ Acidity M.O., $CaCO_3$	mg/l	Iron Ferrous, Fe	ug/l	Beta, Total	pc/l
☐ Hardness Total, $CaCO_3$	mg/l	Lead Total, Pb	ug/l	Beta, Diss	pc/l
☐ Residue, Total	mg/l	Lithium Total, Li	ug/l	Beta, Suspd	pc/l
☐ Residue, Total Volatile	mg/l	Manganese Total, Mn	ug/l	Alpha, Total	pc/l
☐ Residue, T[illegible]	mg/l	Mercury Total, Hg	ug/l	Alpha, Diss	pc/l
☐ Residue, [illegible]	mg/l	Molybdenum Total, Mo	ug/l	Alpha, Suspd	pc/l
☐ Residue, Total [illegible]	mg/l	Nickel Total, Ni	ug/l	Radium 226, Total	pc/l
☐ Residue, Vol Filt	mg/l	Selenium Total, Se	ug/l	Strontium 90, Total	pc/l
☐ Residue, Settlable	mg/l	Silver Total, Ag	ug/l	Coliform Total, MF	#/100ml
☐ Nitrogen Organic, N	mg/l	Strontium Total, Sr	ug/l	Coliform Total MPN, Conf	#/100ml
☐ Nitrogen Ammonia, N	mg/l	Thallium Total, Tl	ug/l	Fecal Coli Total, MF	#/100ml
☐ Nitrite, N	mg/l	Tin Total, Sn	ug/l	Fecal Strep Total, MF	#/100ml
☐ Nitrate, N	mg/l	Titanium Total, Ti	ug/l	Plate Count, Total	#/ml
☐ Phosphorus Total, P	mg/l	Tungsten Total, T	ug/l	Algae, Total	#/ml
☐ Phosphorus Soluble, P	mg/l	Vanadium Total, V	ug/l		
☐ Phosphate Total, PO_4	mg/l	Zinc Total, Zn	ug/l		
☐ Phosphate Ortho, PO_4	mg/l	Zirconium Total, Zr	ug/l		
☐ Sulfate, SO_4	mg/l	BOD, 5-Day	mg/l		
☐ Sulfite, SO_3	mg/l	COD	mg/l		
☐ Sulfide, S	mg/l	Chlorine Demand, 15 min	mg/l		
☐ Chloride, Cl	mg/l	Carbon Total Org, C	mg/l		

COPY DISTRIBUTION: White – Central Office Yellow – District Office Pink – Owner Blue – Data Processing Green – Laboratory

Appendix B
5

JAMES A. RHODES, Governor

EMMETT W. ARNOLD, M.D.
Director of Health

450 East Town Street
P.O. Box 118
Columbus, Ohio 43216

State of Ohio

Department of Health

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TO: Water Works Superintendents, Chemists, Bacteriologists and Operators

FROM: A. L. Fishback, Engineer-in-Charge, Water Supply Unit

SUBJECT: Bacteriological Examination of Water

The following changes are made in the requirements for the bacteriological examination of water.

1. The membrane filter procedure will be the standard procedure for the examination of water for the presence of members of the coliform group. Examination by the fermentation tube test will continue to be accepted.
2. Raw (untreated) surface water shall be examined for both total coliform and fecal coliform.
3. Ground water and treated surface water will continue to be examined for total coliform only.
4. The minimum frequency of sampling from the source and plant for bacteriological examination shall be in accordance with Table A.
5. The minimum frequency of sampling from the distribution system for bacteriological examination shall be in accordance with Table B.
6. All surface water supplies will be expected to provide approved laboratory facilities or to contract with an approved laboratory for the bacteriological examination of water.
7. Ground water supplies serving 10,000 or more persons will be expected to provide approved laboratory facilities or to contract with an approved laboratory for the bacteriological examination of water.
8. Ground water supplies serving less than 10,000 persons may continue to have routine samples examined by the laboratories of the Ohio Department of Health.

Compliance with the above requirements will be expected as soon as possible and not later than June 1, 1972. If there are questions concerning this change of requirements, please contact this office at telephone number 614 469-4994. We shall appreciate your cooperation.

TABLE A

MINIMUM FREQUENCY OF SAMPLING FROM SOURCE AND PLANT FOR BACTERIOLOGICAL EXAMINATION

Source of Supply	Minimum Frequency of Sampling
Ground Water Not Subject To Contamination	Monthly
Ground Water Subject To Contamination	Weekly
Surface Water From Upground Reservoir	Weekly
Surface Water From Lake Or Impounding Reservoir	Daily
Surface Water Direct From Stream	Daily

Definition:

Source - Untreated water at the source of supply or entrance to the distribution system.

Plant - Treated water at the entrance to the distribution system.

Ohio Department of Health
Division of Engineering
Water Supply Unit

TABLE B

MINIMUM NUMBER OF SAMPLES TO BE COLLECTED FROM WATER DISTRIBUTION SYSTEMS FOR BACTERIOLOGICAL EXAMINATION

Population Served	Min. No. of Samples Per Month	Population Served	Min. No. of Samples Per Month	Population Served	Min. No. of Samples Per Month
2,000 (or Less)	2	20,400 (or Less)	24	115,000 (or Less)	120
2,900	3	21,200	25	130,000	130
3,800	4	21,900	26	150,000	140
4,500	5	22,700	27	170,000	150
5,300	6	23,500	28	200,000	160
6,100	7	24,300	29	230,000	170
7,000	8	25,000	30	270,000	180
7,800	9	28,000	35	310,000	190
8,500	10	32,200	40	360,000	200
9,200	11	36,100	45	400,000	210
10,000	12	40,000	50	450,000	220
11,700	13	44,000	55	500,000	230
12,500	14	48,000	60	550,000	240
13,300	15	52,000	65	600,000	250
14,000	16	58,000	70	700,000	260
14,800	17	61,000	75	750,000	270
15,600	18	67,000	80	800,000	280
16,400	19	72,000	85	850,000	290
17,200	20	80,000	90	900,000	300
18,000	21	87,000	95	1,000,000	320
18,800	22	95,000	100		
19,600	23	100,000	110		

Ohio Department of Health
Division of Engineering
Water Supply Unit

PROCEDURE FOR DETERMINING THE FREQUENCY OF WATER BACTERIAL SAMPLING AT WATER SUPPLY SYSTEMS SERVED THROUGH MASTER METERS

The following procedure is used in determining the frequency of water bacterial sampling at water supply systems served through master meters.

Formula

$$D = \frac{A \times C}{B}$$

Where: A - Population served in master metered water supply system

B - Total population served by water supply system supplying the water

C - Number of system water bacterial samples required each month based on total population served by supplier

D - Number of system water bacterial samples that should be collected from the master metered water supply system each month

Example Bexley water supply system

(A) 15,000 - Population served by Bexley

(B) 648,000 - Population served by Columbus water supply system

(C) 250 - Minimum number of samples to be examined from Columbus water supply system

$$D = \frac{A \times C}{B}$$

$$= \frac{15{,}000 \times 260}{648{,}000}$$

$$= 6.0$$

Therefore, 6 samples should be collected from the Bexley water supply system each month.

Ohio Department of Health
Division of Engineering
Water Supply Unit

5/67

Appendix B
6

# Laboratory Approval Program
for
Control of Water Quality

Due to fluctuations in supervisory and operating personnel, yearly renewal of a simple certificate of approval, with a conspicuous expiration date, will give us better control.

Prompt submitting of satisfactory reports should be one of the conditions of approval.

Establish a policy of allowable deviations from the text of Standard Methods.

Establish acceptable minimums of quality in material, equipment, reagents, primary standards, etc., used in every phase of laboratory procedure, i.e.; a reliable electric pH meter should be used wherever any treatment is practiced.

Prepare the scope of analyses that should be expected on each individual supply.

Insist that *all* chemicals used, either in laboratory [illegible] in treatment processes, be purchased from reliable suppliers, and that the assay of these chemicals be furnished.

An operator should be familiar with the use of primary chemical standards for each test that is required on that supply.

Bacteriological laboratory approval is based on the assumption that samples are run each day, at some rather regular time, by the one person whose name appears on the certificate of approval. The Engineering Division has to follow through, in the cases where contamination persists in the distribution system. The laboratory retains its approved status as long as their results show this contamination. It is not rescinded for lack of skill or initiative in tracing and removing or overcoming the source of the contamination.

Chemical tests are run at intervals throughout the day's operation of the plant, by operators working in shifts. So the approval certificate would have to carry the names of these operators and list the tests each one might be required to make on his shift. Otherwise, the chief operator would be held responsible for the accuracy of the results from each operator, along with his ability and initiative to take corrective steps in operation control whenever analytical results suggest improved operation. If the latter type of approval is adopted, the chief operator must be given full control of acceptance or rejection of the operators under his supervision.

Further consideration suggests that it would take up to several weeks to evaluate the preparation of known standards and check out all possible interferences in each test in each supply, in addition to checking out each of the wide variety of non-standard "kits" in the various laboratories.

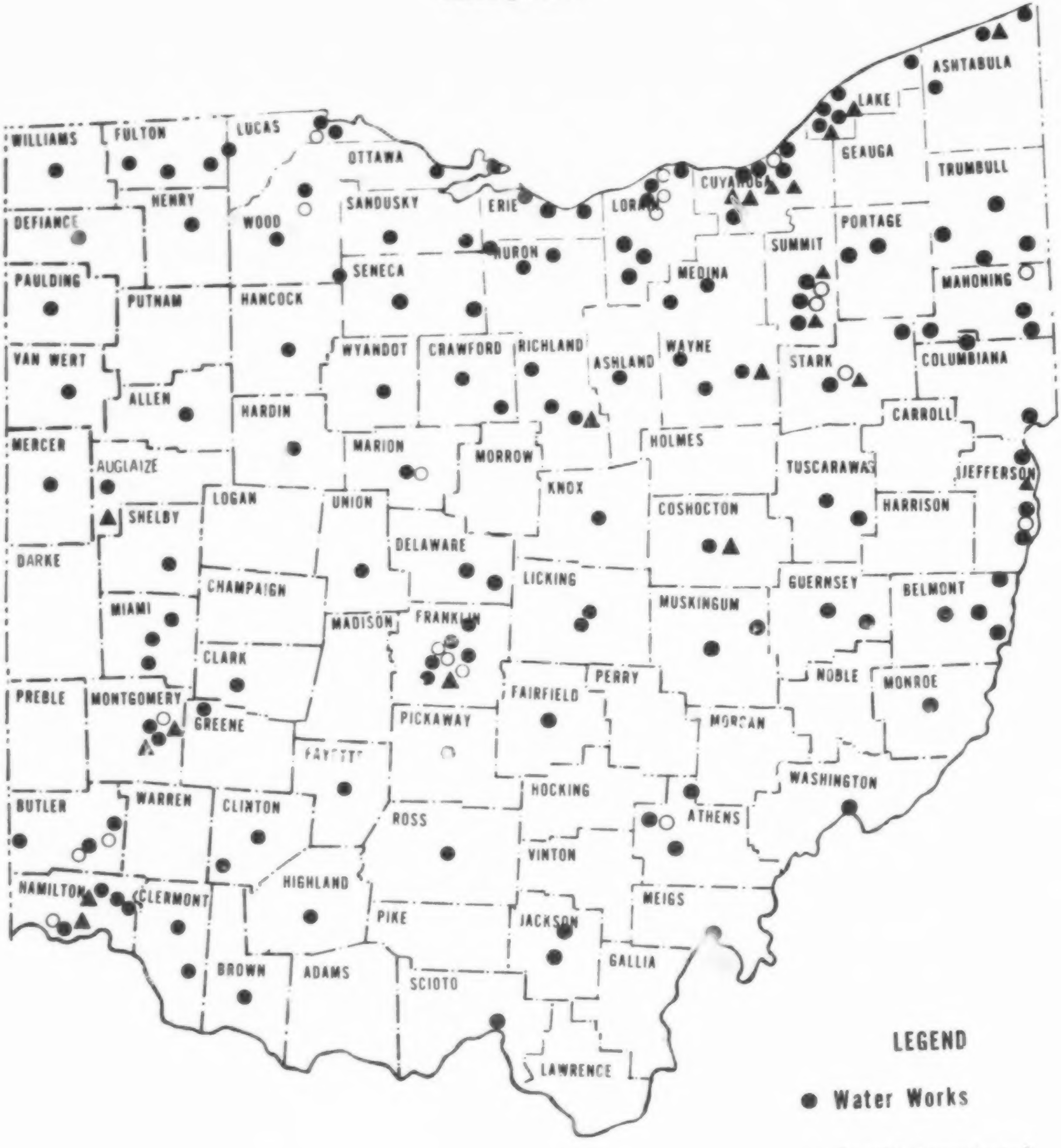
An alternative calls for carrying into the field reagents, supplies, instruments, and glassware to run parallel tests for comparisons. The list of necessary supplies for this type of survey appears to be too great for even a trailer laboratory.

This leaves a third alternative of reference samples being made up at the central laboratory and sent out to the various water plants, basing approval on their results, whether or not they use Standard Methods.

Laboratories Approved for Bacteriological Examination of Drinking Water

Ohio Department of Health

January, 1971


WILLIAMS
FULTON
LUCAS
OTTAWA
ASHTABULA
LAKE
GEAUGA
TRUMBULL
DEFIANCE
HENRY
WOOD
SANDUSKY
ERIE
LORAIN
CUYAHOGA
PORTAGE
SUMMIT
HURON
SENECA
MEDINA
MAHONING
PAULDING
PUTNAM
HANCOCK
VAN WERT
WYANDOT
CRAWFORD
RICHLAND
ASHLAND
WAYNE
STARK
COLUMBIANA
ALLEN
HARDIN
CARROLL
MERCER
AUGLAIZE
MARION
MORROW
HOLMES
TUSCARAWAS
JEFFERSON
LOGAN
UNION
KNOX
COSHOCTON
HARRISON
SHELBY
DARKE
DELAWARE
LICKING
GUERNSEY
BELMONT
CHAMPAIGN
MIAMI
MADISON
FRANKLIN
MUSKINGUM
CLARK
NOBLE
MONROE
PERRY
PREBLE
MONTGOMERY
GREENE
FAIRFIELD
PICKAWAY
MORGAN
FAYETTE
HOCKING
WASHINGTON
BUTLER
WARREN
CLINTON
ROSS
ATHENS
VINTON
HAMILTON
CLERMONT
HIGHLAND
MEIGS
PIKE
JACKSON
BROWN
ADAMS
SCIOTO
GALLIA
LAWRENCE

LEGEND

● Water Works

○ Health Department

▲ Private or Industry

Report of a Survey of the
Ohio State Health Department
Water Chemistry Laboratory
1571 Perry Street
Columbus, Ohio 43201

by

Earl F. McFarren, Chief
Analytical Quality Control
Water Supply Programs Division

The water chemistry laboratory of the Ohio State Department of Health at 1571 Perry Street, and the Water Supply Unit at 450 East Towne Street was visited on February 14th and 15th, 1972. The equipment and procedures employed in the chemical analysis of water by this laboratory conforms with the provisions of Standard Methods for the Examination of Water and Wastewater (13th edition) and with the provisions of the Public Health Drinking Water Standards, except for the items marked with a cross "X" (deviation from standard), or an "O" (not being done at present). Items marked with a "U" could not be determined at the time of the survey.

Substances Determined

The water laboratory routinely determines color, turbidity, chlorides, fluorides, nitrates, sulfates, total dissolved solids, barium, cadmium, chromium, copper, iron, lead, manganese, silver and zinc as required by the drinking water standards. In addition, they also routinely determine calcium, magnesium, sodium, potassium, aluminum, beryllium, hardness, pH, and alkalinity (total, phenolphthalein, and $CaCO_3$) even though these are not required. At present, they do not do odor, cyanide, carbon chloroform extract, surfactants, arsenic, selenium, mercury, gross beta, radium 226, or strontium 90. Thus in summary, although they routinely do twenty-nine determinations, only sixteen of these are required by the drinking water standards, and ten substances specified in the standards are seldom, if ever, done. Turbidity (item 1 c) is the only substance being determined at present by a non-standard method.

Laboratory Apparatus

They have the equipment available in the Industrial Chemisty Section under Mr. Weigelt, to do gross beta, radium 226, and strontium 90, but at present, there are no plans for its use in the analysis of potable waters.

The Sanitation Chemistry Section (water laboratory under Mr. Walker) also has the equipment for mercury analysis and are purchasing equipment for the analysis of arsenic and selenium by atomic absorption. They also have on order an auto-analyzer which will enable them to do cyanide and surfactants. They do not have the equipment for the determination of the carbon chloroform extract and it was recommended that they wait until the new mini-sampler becomes available. It was recommended that they purchase a Hach Model 2100 turbidimeter.

Samples

It is recommended that samples collected for metal analysis be preserved with nitric acid (item 32 a) and those collected for nitrate and surfactant analysis be either refrigerated or preserved with mercuric chloride (item 32b).

Records

According to laboratory records 2614 samples were analyzed last year (each for about 29 substances). Since there are about 800 municipal water supplies in the state, this means that on the average each water supply was analyzed three times last year. However, no print out of the data by supplies was available at the moment, although all data has been key-punched and presumably will be available eventually. In addition, there were 911 samples analyzed for fluorides. Since there are about 130 supplies which fluoridate, presumably they should have analyzed about 1560 samples (assuming all supplies are checked once a month).

Laboratory

The Sanitary Chemistry Laboratory is responsible for the analysis of both potable and raw or polluted waters. The laboratories consist of two laboratories about 20 by 40 feet each and one laboratory about 20 by 20 feet. In addition, the chief has an office about 10 by 10, a storage room for chemicals about 10 by 10, a glassware cleanup room about 20 by 20 and a bottle and miscellaneous storage area about 10 by 10 feet. The Industrial Chemistry Laboratory is responsible for any radiochemistry analysis, and is not part of the water (sanitary) chemistry laboratory. In any case the space available to both is more than adequate. Apparently, the Industrial Chemistry laboratory, also has some capability for doing pesticide analysis, but none was done on water last year.

Quality Control

The laboratory does routinely check the quality of their distilled and deionized water (when used), but otherwise, has no routine program for checking the quality of their analyses (item 42).

If this laboratory desires to be certified for analysis of those chemistries which they are now running routinely, it will be necessary for them to establish their proficiency by analyzing a reference sample which we can supply.

Staff

The water chemistry staff consists of a chief chemist who devotes about one half of his time to problems concerned with potable water analysis, two assistant chemists with degrees, and one technician.

In general, the salaries of all appear to be low and the number is inadequate to carry out all the desired chemistries. However, a change in emphasis would permit some required chemistries to be done which are not now done. If radiochemistries and pesticide analysis are to be done, however, at least two more persons would be required.

Conclusions

The water chemistry laboratory routinely analyzes for 29 substances, but only 16 of these are required by the drinking water standards, and 10 substances that are in the standards are seldom, if ever, run.

The laboratory analyzed 2614 samples last year, and since there are only about 800 municipal supplies in the state it would appear that each was analyzed on an average of about 3 times last year. Although last year's data has been key-punched, no print out is yet available to check or verify these conclusions. A summary was available of those supplies analyzed during the period from 1968 to 1969.

About 130 water supplies in the state are fluoridated, and if each was checked just once a month, presumably 1560 samples should have been analyzed; whereas, only 911 samples were analyzed for fluoride.

The equipment is available, or will be shortly, so that all of the chemistries specified by the drinking water standards except carbon chloroform extraction could be carried out, however, more personnel would be needed if the additional chemistries are to be undertaken. Another chemist would be needed if the radiochemical analysis of potable waters were to be undertaken, and likewise another chemist would be needed to carry out pesticide analysis. The other water chemistries could be undertaken, however, without an increase in staff, simply by making a change in emphasis; namely, substituting some of the required chemistries for those now being done but not required.

The salaries of all laboratory personnel appear to be low.

Metal samples and samples for nitrate and surfactant analysis are not now properly preserved.

The laboratory does not have any routine system for checking their laboratory performance, although they have in the past participated in Analytical Reference Service studies. In view of the emphasis now being placed on quality control by all government agencies, it was suggested that the Chief Chemist take a short course in "Analytical Quality Control."

It was recommended that a Hach Model 2100 turbidimeter be purchased.

Earl F. McFarren

SURVEY OF WATER CHEMISTRY LABORATORIES

ENVIRONMENTAL PROTECTION AGENCY
Office of Water Programs
Water Hygiene Division

Indicating conformity with the 13th edition of Standard Methods for the Examination of Water and Wastewater (1971).

Survey by Earl F. McFarren

Date February 14-15, 1972

X = Deviation U = Undetermined

O = Not Used

Laboratory State Health Department

Director Charles C. Croft

Street 1571 Perry Street

Chief Chemist Wilson Walker

City Columbus State Ohio 43201

Water Supply Chief A.L. Fishback

Substances Determined

		Method	
1. Physical determinations			
a.	color	platinum-cobalt standard method	
b.	odor		O
c.	turbidity	Jackson candle	X
2. Miscellaneous anions, organics and solids			
a.	chlorides	argentometric (silver nitrate)	
b.	cyanide		O
c.	carbon chloroform extract		O
d.	fluorides	electrode	
e.	nitrates	phenoldisulfonic acid	
f.	sulfates	turbidimetric	
g.	surfactants		O
h.	total dissolved solids	103° gravimetric	
i.	other		
3. Metals			
a.	arsenic		O
b.	barium	Atomic absorption	
c.	cadmium	" "	
d.	chromium	" "	
e.	copper	" "	
f.	iron	" "	
g.	lead	" " (verified by boat)	
h.	manganese	" "	
i.	selenium		O
j.	silver	" "	
k.	mercury		O
l.	zinc	" "	
m.	other	Calcium, magnesium, sodium, potassium, aluminum and beryllium, hardness, alkalinity, and pH.	

4. Radioactivity
   a. gross beta 0
   b. radium 226 0
   c. strontium 90 0
   d. other

5. Pesticides
   a. aldrin 0
   b. chlordane 0
   c. dieldrin 0
   d. DDT 0
   e. endrin 0
   f. heptachlor 0
   g. heptachlor epoxide 0
   h. methoxychlor 0
   i. lindane 0
   j. toxaphene 0
   k. total organic phosphates plus carbamates 0
   l. chlorinated phenoxy alkyl pesticides 0
   m. other

Laboratory Apparatus

	Make	Model	
6. Color comparators			
a. visual			
b. filter photometer			
7. Spectrophotometer			
a. visible	Beckman (2)	Model B	
b. flame			
c. other	Ultraviolet Spectrophotometer	Perkin-Elmer 402	
8. Atomic absorption spectrophotometer			
a. air-acetylene burner	Perkin-Elmer (2)	403	
b. nitrous-oxide burner	" "	"	
c. cold vapor (flameless)	" "	"	
9. Gas chromatographic equipment			
a. electron capture			
b. flame ionization			
c. flame photometric			
d. microcoulometric			
e. other			

Laboratory	Location	Date
Ohio State Department of Health	1571 Perry Street	2/14-15/72

	Make	Model	
10. Other chromatographic equipment			
a. thin-layer			
b. Kuderna-Danish evaporator			
c. other			
11. Turbidimeter			X
12. Amperometer			
13. Titrimeter			
14. pH meter	Corning Model 10, Beckman SS-1 (3)		
15. Fluoride electrode	Beckman		
16. Arsine generator	have, but seldom use		
17. Cyanide still	2 stills		
18. Fluoride still			
19. Carbon-chloroform extraction equipment			
a. high or low flow columns			O
b. carbon drying oven			O
c. extraction apparatus			O
d. manifold for solvent evaporation			O
20. Drying oven	Thelco and Fress		
21. Steam bath	Yes		
22. Hot water bath	Yes		
23. Muffle furnace	Thermolyne		
24. Distilled water still	2 - 5 gal/hr Consolidated stills		
25. Water deionizer	laboratory cartridges		
26. Conductivity meter	Industrial Instruments		
27. Balance, sensitive to 0. 1 mg	Mettier H207, Satorius		
28. Automatic analyzer for			
a. nitrates plus nitrites	on order		
b. nitrites	on order		

		Make	Model	
28.	Automatic analyzer for (Continued)			
c.	chloride			
d.	sulfate			
e.	cyanide	on order		
f.	fluoride			
g.	other	phosphates, ammonia, phenol, MBAS, Kjeldahl on order		
29.	Radiation Counting Equipment			
a.	internal proportional counter	Beckman	Widebeta II	
b.	alpha-scintillation counter	Beckman,	Liquid Scintillation LS-233	
c.	other	Lowbeta II, Gamma Ray Spectrometer		
30.	Other Instruments or Equipment			
a.				
b.				
c.				
d.				

Samples

31. Containers

a. Non-reusable plastic containers preferred for the collection of samples for general inorganic analysis. . . . . ____

b. Glass bottles with teflon lines caps preferred for collection of pesticide samples . . . . ____

c. Other kind . . . . ____

32. Preservatives

a. Samples for metal analysis preserved by the addition of nitric acid to a pH of about 2.0 X

b. Nitrates and methylene blue active substances preserved by addition of mercuric chloride X

c. Cyanide preserved by the addition of sodium hydroxide to a pH of 11. . . . . O

d. No known or required preservative for turbidity, color, pH, chloride, sulfate, fluoride, specific conductance and total dissolved solids. . . . . ____

e. If no preservative is used, in general samples are analyzed within 72 hrs . . . . ____

Laboratory	Location	Date
Ohio State Department of Health	1571 Perry Street	2/14-15/72

33. Identification

a. Every bottle should be identified by attaching an appropriately inscribed tag, a label or a number corresponding to a sample identification sheet. . . . . ____

b. The minimum information required on the tag or correspondingly numbered sheet includes; name of the water supply sampled, location of sampling site, exact date and time of collection, type of sample (raw, finished, grab or composite) by whom collected, and kind of preservative if added . . . . ____

34. Collection

a. Samples from wells collected after pumping for a sufficient time to assure that the sample is representative of the ground water which feeds the well. . . . . U

b. Finished (treated) water sampled at the plant by use of a pipeline drip device or the collecting and compositing of hourly (or other interval) samples . . . . U

c. Distribution samples obtained at several different points in the system; usually grab samples obtained without first flushing the line, although both kinds of samples may at times be desirable. . . . . U

Records

35. Availability

a. Assay results assembled and available for inspection . . . . ____

b. Notation made of those water supplies which did not comply with one or more standards, and some sort of follow-up program instigated . . . . ____

36. Number analyzed annually

a. private supplies ____ very few ____ ____

b. semi-public ____ U

c. municipal ____ 2614 samples in 1971 (61,484 analyses) ____ ____

(1) sources ____ ____

(2) finished ____ ____

(3) distribution ____ ____

37. Frequency

a. Physical characteristics measured at least once a week and preferably every day at the treatment plant. . . . . ______

b. Chemical characteristics determined at least once every three years on ground water supplies and semi-annually on surface water supplies unless previous data has indicated a potential problem which needs to be monitored more frequently ______

Laboratory

38. Physical facilities

a. Bench top area adequate . . . . ______

b. Sufficient cabinet space for chemicals and glassware . . . . ______

c. Adequate hood space. . . . . ______

d. Office space available for record keeping and processing reports . . . . ______

e. Space for storage and handling of bottles. . . . . ______

39. Glassware

a. Thoroughly washed with suitable detergent and warm water . . . ______

b. Rinsed immediately in clean tap water to remove detergent . . . ______

c. Final rinse with distilled water. . . . . ______

d. Dichromate cleaning solution used for difficult to clean glassware. . . . . ______

e. Glassware used for pesticide analysis should receive a final rinse with A. R. grade acetone or ethyl acetate . . . . O

40. Organization

a. Total number of laboratories examining water 1 . . . . ______

b. Water laboratory is a separate unit, and not part of a food, drug, or toxicological laboratory . . . . ______

c. Each of the other regional laboratories have the same capabilities. . . . . ______

d. Radiation chemistry is a part of the water laboratory X

Quality Control

41. Laboratory water quality

a. Conductivity of water checked at regular intervals . . . . ______

b. Use of deionized water for metal analysis X
distilled water checked, and not found necessary.

Laboratory	Location	Date
Ohio State Department of Health	1571 Perry Street	2/14-15/72

42. Control Samples

a. A control sample of known composition (in addition to any necessary standards) is analyzed every time one or more unknown samples are analyzed. X

b. A control sample is available and used for each substance specified in the drinking water standards X

c. A control chart has been constructed for each substance, and the precision of each determination has been calculated X

43. Reference Samples

a. Accuracy and ability of laboratory to perform each analysis checked by requiring them to analyze an unknown reference sample(s) supplied by the surveying office or laboratory at least once a year X

Staff

44. Personnel

a. Total number of staff 3 1/2 . . . . ____

b. Number with degrees in chemistry 3 . . . . ____

c. Does state operate under a merit system. . . . . ____

d. Are job descriptions written . . . . ____

e. Does state encourage attendance at professional meetings, short courses, etc. ____

45. Salaries

a. Chief chemist $11, 602 B. A. . . . . ____

b. Assistant chemist $8 to 9, 000 (2). B.A. . . . . ____

c. Aids $5, 096 (1) . . . . ____

Appendix C

Manpower Needs for Community Water Supply Activities

Two estimates of manpower requirements are presented in this appendix. The first was prepared by the Water Supply Unit using criteria established by the Division of Water Supply of EPA. The Region V office of EPA finds this estimate with its assumptions to be accurate. The second estimate was prepared by the Water Supply Section, EPA, Region V, using the task evaluation method. This method requires the definition of tasks which must be done, the number of sources generating the task, the number of times the task must be done for each source, and the time required to accomplish each task.

Differences in the two estimates are: the first estimate assumes greater emphasis on cross connection control than the second, the first includes planning while the second does not, and the first assumes greater State participation in water supply operator training than the second. Neither estimate provides for the surveillance of water supply facility waste discharges.

Requirements for Professional Personnel in the Administration of a Community Water Supply Program in Ohio by Experience Estimate Method

A. Assumptions:(1)

1. 858 community water supply systems (1971).

2. 4 man days/public water supply/year (includes plans review, meeting with governing bodies, surveys, report writing, training, etc. - does not include cross connection control activities).

3. Cross connection control requirements for water supply systems based on the following:

Population Served by System	Man days/System/Year
Over 250,000	6
50,001 to 250,000	5
25,001 to 50,000	4
10,001 to 25,000	3
5,001 to 10,000	2
0 to 5,000	1

4. 225 man days equals one man year.

5. Man days required does not include personnel requirements for auxiliary facilities or clerical help.

B. Professional Personnel Required

1. Community Water Supply

$$858 \text{ systems } x\ 4\ \frac{\text{man days}}{\text{system}} = 3432 \text{ man days}$$

$$\frac{3432 \text{ man days}}{225\ \frac{\text{man days}}{\text{man year}}} = 15.3 \text{ man years}$$

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(1) Assumptions follow pattern used by Bureau of Water Hygiene, EPA, in January, 1971, report on Evaluation of the Tennessee Water Supply Program.

2. Cross Connection Control

Population	No. of Systems	Man Days System	Man Days Group
Over 250,000	7	6	42
50,001 to 250,000	11	5	55
25,001 to 50,000	20	4	80
10,001 to 25,000	61	3	183
5,001 to 10,000	57	2	114
0 to 5,000	602	1	602
	758*		1076

$$\frac{1076 \text{ man days}}{225 \frac{\text{man days}}{\text{man year}}} = 4.8 \text{ man years}$$

3. Total

Community Water Supply	15.3 man years
Cross Connection Control	4.8 man years
	20.1 man years

C. Present Status

Area	Present Staff
Water Supply Unit	5
District Offices	4
	9

To meet the required number of professional personnel it will be necessary to increase the staff from the present nine to 20, or an increase of 11 professional personnel.

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* Does not include satellite systems.

D. Plan for Reorganization

Area	Present Staff	Proposed Staff
Water Supply Unit		
Engineer-in-Charge	1	1
Plans Review	1	2
Operations	2	4
Water Quality	1	2
Planning		1
Training		1
Enforcement		1
Total	5	12
District Offices		
Northeast	1	3
Southeast	1	2
Southwest	1	2
Northwest	1	2
Total	4	9

* It is estimated that one district engineer can cover about 100 public water supply systems each year on the basis of two man days per system for inspections and report writing only.

Estimate of Professional Personnel Needed for Public Water Supply Surveillance in Ohio by Task Definition Method

This method first defines the organization to accomplish the basic objective, divides tasks into three basic functions or classes, defines the tasks necessary to accomplish the objective and assigns those tasks to logical offices or sections within the organization and finally uses estimates of the number of sources, number of task units generated by each source per year, and man hours per task unit to determine the manpower requirement to obtain the objective.

The manpower requirement, not including planning and well log functions, presently done by the Department of Natural Resources, and not including secretarial staff, is estimated at 15 professional personnel as shown by the summary. Bureau of Laboratory manpower requirements are not included.

Summary of Manpower Needs

Water Supply Unit					
Chief's Office		2000 hr.	=	1.1	1
WQ Section		1188 hr.	=	0.7	1
Operations Section		5404 hr.	=	3.1	3
Plans Review Section		4000 hr.	=	2.3	2
					7
All Districts		12648 hr.	=	7.2	7
Divide District need based on number of water supplies					
SE	$\frac{155}{750}$ X 12648 =	2610	=	1.5	2
SW	$\frac{176}{750}$ X 12648 =	2970	=	1.7	2
NE	$\frac{214}{750}$ X 12648 =	3610	=	2.1	2
NW	$\frac{205}{750}$ X 12648 =	3460	=	2.0	2
					8

Steps for Professional Personnel Estimate by Task Definition Method

A. Organizational Structure to Accomplish Tasks

Water Supply Unit

- Chief's Office
- Water Quality Section
- Operations Section
- Plans Review Section

District Offices

B. Task Classification

- Administration
- Surveillance
- Compliance

C. Task Definition by Structural Section or Office

Chief's Office

Administration

1. Technical assistance (include review of other agency output)
2. Liaison with other agencies concerned with water supply
3. Training assistance
4. Direction of program activities

Compliance

1. Guide action against violators

Water Quality Section

Administration

1. Maintain and develop liaison with other organizations requiring or having water quality data.

   Water Supply Section, EPA (Cincinnati and Chicago)
   Water Pollution Laboratory, EPA, Cincinnati
   District Office, EPA, Cleveland
   U.S. Geological Survey
   Water Pollution Unit, Department of Health
   Department of Natural Resources
   Others

2. Develop programs for the storage and retrieval of water quality data to meet varied needs.

   Statewide surveys
   District surveys
   Data on individual water supplies
   Data on specific sources

. Technical Assistance (includes training aid)

Surveillance

1. Develop sampling programs

2. Follow up Bureau of Laboratory results to see that program goals are met.

3. Maintain check and control over Bureau of Laboratory bacterial and chemical laboratory certifications.

Compliance

1. Conduct field investigations to confirm and remedy finished water quality exceeding the Drinking Water Standards

Operations Section

Administration

1. Technical Assistance, provide consultation, assist chiefs office in training function.

2. Check water supply classifications (information vital to Certification Committee)

3. Develop programs for the storage and retrieval of operations data to meet varied needs. Prepare reports from such data.

   Feedback to District offices

   Feedback to water supplies

   Preparation of District and Statewide reports

   Special studies

4. Assist District Offices in developing inspection programs.

Surveillance

1. Receive and manage monthly reports

2. Manage interstate carrier inspections and reports.

3. Maintain surveillance over fluoridation of public water supplies

4. Assist development of cross connection control programs.

5. Manage bacteriological sampling and reporting program (should be under WQ Section)

Compliance

1. Develop data for action against water supplies violating State regulations.

Plans Review Section

Administration

1. Technical assistance (including training aid)

Surveillance

1. Develop and maintain program on status of installation

Compliance

1. Review and evaluate plans for water supply

District Offices

Administration

1. Technical Assistance

Surveillance

1. Provide information to Water Supply Unit
2. Process operators reports, maintain records on such reports
3. Maintain bacterial records
4. Conduct annual and detailed inpsections

Compliance

1. Develop data on violations of Department regulations and law in cooperation with the Water Supply Unit for enforcement action.

D. Derivation of Manpower Requirements

Task	Unit	# of Sources	Work load per source per year	Man hours per work load unit	Manhours per year
Chief's Office					
A-1	Request for assist	100	1	4	400
A-2	Meeting + followup	15	4	8	480
A-3	Liaison with oper. train. comm.+followup	2	8	8	128
A-4	Develop & check policy	7	12	8	672
C-1	Enforcement cases	10	4	8	320
				Total	2020
1+ man year					
Water Quality Section					
A-1	Meetings	8	2	8	128
A-2	Programming	1	8	16	128
A-3	Requests for assist.	50	nature varies 1	2	100
S-1	Schedule devel.	1	2	40	80
S-2	Check of schedule progress, followup	1	12	24	288
S-3	Certification check	1	4	16,	64
C-1	Field Investigation	50	1	8	400
				Total	1188
1- man year					
Operations Section					
A-1	Requests for assist.	200	nature varies 1	1	200
A-2	Check classifications (make 5 yr. program)	160	1	30 min.	80
A-3	Data Evaluation	5	12	16	960
A-4	¼ly meetings and directives	1	4	16	64
S-1	Process monthly reports	800	12	5 min.	800
S-2	Coord. ISC Insp. & Annual Report	25	1	4	100
S-3	Review Monthly Rep. Pursue those not F	120	12	30 min.	720
S-4	Develop programs as Consultant	200	2	4	1600
S-5	Receive mo. report Process	800	12	5 min.	800
C-1	Data Development	20	4	1	80
				Total	5404
3 man years					

Task	Unit	# of Sources	Work load per source per year	Man hours per work load unit	Man hours per year
Plans Review Section					
A-1	Requests for assist	50 nature varies	1	2	100
S-1	Review Dist. reports check & revise invent.	300	1	1	300
C-1	Review & Eval. plans for W.S.(incl. consult of spec. plans)	300	1	12	3600
				Total	4000
2+ man years					
District Offices					
A-1	Requests for Assist.	1000nature varies	1	1	1000
S-1	Monthly Reports & Quart. Staff Meeting	4	12	6	288
S-2	Review Reports Check against Standards	800	12	10 min.	1600
S-3	Review Report, Check Stds., Follow up, Record	800	12	20 min.	3200
S-4	Inspection, Follow up	800	1	8	6400
C-1	Data Development	20	4	2	160
				Total	12648
8 man years					